(2)

22 July 1976

(6)

AN/GRC-171

Rivet Switch

Multichannel UHF/AM Transceiver

Demonstrated Mean Time Between Failure (DMTBF),

(9) Test Report: 22 Sep 75 - 13 JUN 76,

(14) 76-SM/ALC — Ø01

(11) 22 JUL 76 (12) 61 P.

(10)

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FOREWARD

A Demonstrated Mean Time Between Failure (DMTBF) Test was performed on the AN/GRC-171 Multichannel UHF/AM Transceiver as required by contract F34601-73-C-0691. The results of this testing provide pricing information on the contract options. Testing was conducted at the Sacramento ALC Service Engineering Test Laboratory. A list of key test force personnel follows.

Name	Function	Office
Tavares, Robert J. Lt	Test Director	AFLC/MMCREA
McGee, Joseph L.	Lead Engineer	AFLC/MMCREA
Fogel, Charles	Radio Repairer	AFLC/MAIPFB
Westbrook, William	Radio Repairer	AFLC/MAIPFB
McCallum, Duncan	Contractor Technical Representative	Collins Radio

Letter on file

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ABSTRACT

The DMTBF test on the AN/GRC-171 was accomplished at McClellan AFB, CA during the period of 22 Sep 75 through 13 Jun 76. Testing was conducted in the Service Engineering Test Laboratory in a simulated operational environment.

All test radios were controlled and operated by Automatic Test Equipment (ATE). Bench tests were conducted during testing to monitor daily radio performance and determine any failures undetected by the ATE.

CONTENTS

1. INTRODUCTION

1.1 Background: The AN/GRC-171 Simulated Operational Test was included in the original procurement action to provide pricing information based on a Demonstrated Mean Time Between Failure (DMTBF). An analysis based on life cycle costs was conducted to determine maintenance cost to support the transceiver as a result of different MTBFs. Cost incentives and penalties were provided based on the number of MTBF hours above or below predetermined limits.

1.2 Implementation: The actual DMTBF hours were to be determined by a Simulated Operational Test. The cost incentives would be paid as increased unit price on contract options I and II. Pricing penalties including rejection of the options were included to penalize a deficient product.

2. TEST ARTICLE

2.1 Description: The Radio Set AN/GRC-171 is a UHF transceiver intended for worldwide use in the air traffic control environment. The equipment provides AM and wideband data communications on any 1 of 7,000 channels (25 Khz spacing) in the 225- to 399.975 Mhz band. The equipment is completely solid state providing 20 watt AM carrier output and 3 microvolt receiver sensitivity.

2.2 Remote Control: The Radio Set Control (C-7999)/GRC-171 contains controls for remote frequency selection, power on/off, squelch on/off, and receive audio level control. The remote control is edge lighted and contains a transceiver "ready" indicator lamp.

2.3 Intended Use: The Radio Set AN/GRC-171 will typically be installed in the cab of an airport control tower, within the operations room of a radar approach control facility (RAPCON) or in the mobile van of a ground control approach facility (GCA) or mobile RAPCON. In the control tower and RAPCON environments, the transceiver typically would be employed as an emergency backup in the case of failures of remote transmitters or receivers. In the GCA and mobile RAPCON environments, the transceiver may be employed as either a normal communications device during tactical operations or as an emergency backup. The transceiver also may be employed as a versatile backup device at transmitter sites, receiver sites, and colocated VHF/UHF transmitter/receiver sites to provide immediate response in case of additional channel requirements or failure of an operational channel. At remote locations such as radar sites, it is possible that the transceiver may be employed singly or in small numbers to provide ground air channel capacity for air traffic control communications purposes.

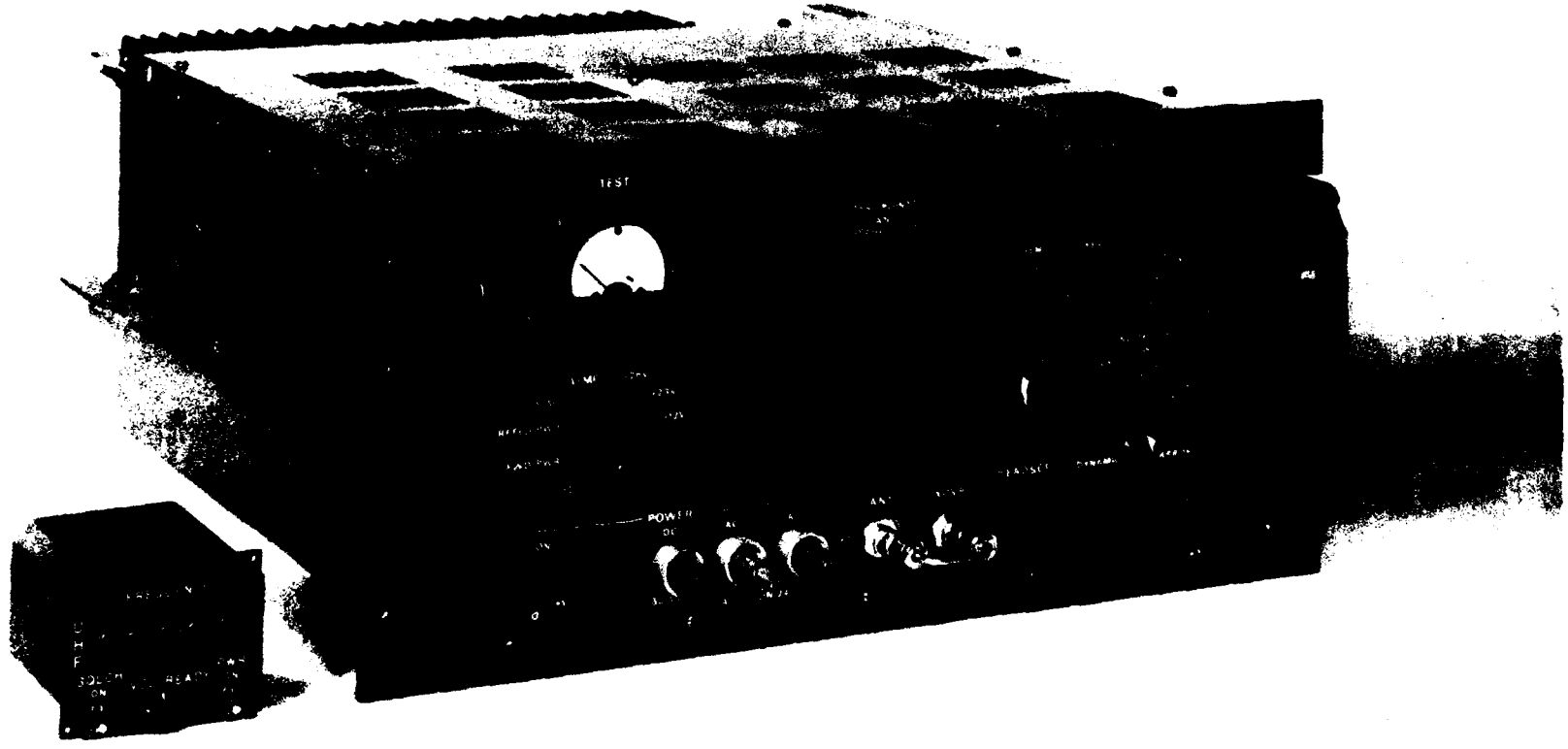


Figure 1
[illegible]-171 - UHF Transceiver;
[illegible]-880/GRC-171 and
[illegible]-880/GRC-171 Radio Set Control

3. TEST PLAN

3.1 A copy of the DMTBF test plan is included in this report for background information. The DMTBF test responsibility has been transitioned to CEM Management Division's Radio Unit (MMCREA) due to functional reorganization of SM-ALC.

TEST PLAN FOR

SIMULATED OPERATIONAL TEST OF

AN/GRC-171 TRANSCEIVER

TEST PLAN FOR SIMULATED OPERATIONAL TEST OF AN/GRC-171 TRANSCEIVER

1.0 SCOPE This document delineates the general testing plan and methods which will be used to accomplish testing in a simulated operational environment in order to establish a Demonstrated Mean Time Between Failure (DMTBF) for the production AN/GRC-171 Transceivers.

2.0 APPLICABLE DOCUMENTS

TECHNICAL EXHIBIT OCNEE 66-69A, 18 October 1967, including Clarifications and Amendments thereof.

CONTRACT F34601-73-C-0691

In the event of conflict between this document and applicable documents, the applicable documents shall govern.

3.0 TEST LOCATION The testing to establish a DMTBF will be accomplished by the Government at McClellan AFB, Sacramento, California in the Engineering Test Laboratory. All facilities, test equipment, instrumentation monitoring equipment and other associated equipment (except for logistic support required to repair failed AN/GRC-171 units) required for this test will be provided by the Government. The transceivers to be tested will be installed in the test configuration by Government personnel at the test site.

4.0 TEST PERSONNEL Testing will be accomplished by Government personnel under the direction of the Sacramento ALC Service Engineering Division. A test director from the Sacramento ALC Service Engineering Division will be designated who will be responsible for the overall management of the test. Government personnel as determined necessary by the test director for proper conduct of the test will be on-site during the normal duty hours of a 40-hour work week. The test will be sufficiently automated and organized so that testing can continue unattended during other periods of time. The test director may, however, at his own option, elect to have test personnel on-site at any time.

5.0 ON-SITE CONTRACTOR PERSONNEL The contractor is required to have a representative present at the test site during normal duty hours throughout the test. The contractor representative will be on-site for the purpose of: (a) witnessing the failures verified by the Government test personnel; (b) assisting Government personnel in failure analysis; and (c) perform adjustments, repair, replacement, or maintenance necessary to restore a failed unit to an operational status, as directed by the Government. The contractor representative will not be considered a part of the test team. The contractor representative shall not perform any of the above tasks except by specified direction of the test director.

6.0 TEST UNITS AND DURATION OF TESTS Test units shall consist of thirty (plus 3 backup) AN/GRC-171s selected at random by the Government from the first three months production quantity. Eleven units shall be selected from each of the first three months of production. The transceivers selected shall be shipped to the test site following each of the first three months of production. As each lot is received at the test facility, they will be given a pre-test checkout (see Appendix II) and the first ten units per lot to successfully complete this procedure shall be placed under test. The testing shall continue until 5,000 calendar hours have been accumulated on the third lot to be received and put under test. The eleventh unit from each lot shall be held in non-operational standby and placed in test only in the event that one of the units under test cannot be returned to a serviceable condition.

6.1 PRE-TEST CHECKOUT Each transceiver received at the test facility will be subjected to a pre-test checkout by the Government to verify that it meets the requirements specified in Technical Exhibit OCNEE 66-69A before DMTBF testing starts. This test procedure is contained in Appendix II.

7.0 TEST CONDITIONS

7.1 ENVIRONMENTAL The test transceivers will be installed in enclosed equipment racks in a specially designated area of the Sacramento ALC Engineering Test Laboratory. The transceiver cabinet air temperature will be continuously monitored and transceivers will not be operated in ambient air temperatures above 42° C. In no case will test conditions exceed the limits specified in Technical Exhibit OCNEE 66-69A.

7.2 POWER SOURCE The transceivers under test will be operated from standard 60Hz commercial power. The primary power source for operation of the transceivers will be continuously measured and recorded.

8.0 TEST SET-UP AND OPERATION The transceivers will be installed in a test configuration to permit operation simulating that of the normal operational environment. The test units will be operated in a manner and modes simulating operational usage, and performance parameters will be monitored during this time to detect failures and time of failures.

8.1 TRANSCEIVERS UNDER TEST The transceivers will be connected back-to-back in pairs through RF attenuators to permit one transceiver to operate as a transmitter while its appropriate mate operates as a receiver. During the test the transceivers will be alternately keyed and unkeyed by use of an automatic switching device so that during any one time, one transceiver of each pair is transmitting and the other is receiving. The transmit/receive time cycle will be 6 minutes transmit, six minutes receive and in no case will exceed the duty cycle limits specified in OCNEE 66-69A. The transmitting transceiver will be modulated for one-half its transmit cycle with an audio tone from a signal generator, a digital bit stream, or a voice signal from a tape recorder or microphone. The output of the receiving transceiver will be connected to an output monitor. RF power levels of the transmitting transceiver will be routed through coupling devices to an output monitor and measurements will be taken during the unmodulated half of the transmit cycle. The operating frequency of each transceiver will be changed twenty-four times a day under normal operating conditions. A frequency monitoring device will monitor transceiver frequencies during the transmit cycle. In addition, daily bench tests will be conducted on all transceivers under test to monitor transceiver performance degradation (see Appendix II). All transceivers will be "ON" continuously except when they may be turned OFF as a result of a failure or indicated failure, during any test configuration preventive maintenance (scheduled or unscheduled), or during daily bench tests.

8.2 MONITORING FOR FAILURE INDICATION The test configuration will contain instrumentation which will be used to detect failures. Through the use of this monitoring, and by the performance of daily bench tests, various transceiver parameters and performance indicators such as audio, output, transmitter output, transmitter frequency, percent modulation, signal-to-noise ratio, AGC voltage, etc., will be monitored or measured to obtain indications of transceiver performance. Manual operation and monitoring may also be done for any portion of this test at the option of the Government.

9.0 INDICATED FAILURE ANALYSIS AND VERIFICATION OF FAILURE When an indication of transceiver failure is observed during the test, an analysis of the transceiver under test and the test configuration will be accomplished utilizing the transceiver built-in test equipment amd external test equipment. If this analysis reveals that the transceiver does not meet the requirements specified in Technical Exhibit OCNEE 66-69A, the indicated failure will be identified as a verified failure. Any other failures detected during this analysis including those attributable to the test configuration, will be considered verified failures.

9.1 FAILURE CRITERIA AND RELEVENCY OF FAILURES A failure in a unit is defined as any malfunction which requires adjustment, repair, replacement, or maintenance to restore the unit to an operational status. Operational status of a unit is defined as operation of that unit in accordance with the requirements established by the OCAMA Technical Exhibit OCNEE 66-69A dated 18 October 1967, including amendments, and clarifications pertaining thereto. Any failure, whether the failure is identified as a result of an indicated failure during test, the analysis process, bench test or random checks, will be considered a verified failure for the purpose of this test. Except for the following, any failure in a unit will be considered relevant.

(a) Failure of test equipment or monitoring equipment that is external to the unit.

(b) Failure or loss of electrical power source to the unit under test.

(c) Failure caused by damage resulting from external accident.

(d) Failure caused by improper operation or maintenance by Government personnel.

(e) Secondary failures resulting directly from a primary failure.
(f) Elapsed time indicators.

The determination as to whether a failure is applicable to the exceptions "a" through "f" above shall be made by the Sacramento ALC Engineering Test Director or his delegated representative. The contractor may submit to the Procuring Contract Officer (PCO) and the Sacramento ALC Engineering Test Director, any evidence in an attempt to prove that a failure should not be considered relevant.

10.0 REPAIR AND RESTORATION OF FAILED UNITS TO TEST After a failure is verified, if the transceiver can be restored to operation by replacement of modules, the government personnel will replace the module (or modules) and the unit will be returned to test. The failed module will then be repaired by the contractor. After the module is repaired, that module will be returned to its original transceiver and testing will continue. During repair, the established base line configuration of the module will not be altered. If the transceiver cannot be readily restored to operation by module replacement, the entire transceiver will be replaced in the test configuration by one of the backup units until such time as the failed transceiver has been repaired by the contractor. At that time, the repaired

transceiver may be put back in the test or used as a backup unit at the discretion of the Government. The contractor is responsible for providing all parts and materials required for repair of failed modules and transceivers.

10.1 REPAIR VERIFICATION TIME: When repairs to a transceiver have been completed, a 48 hours Failure Free verification period will be accomplished. Test time accumulated during this period will not be counted and any failures to the repaired transceiver occuring during this time will be considered non-relevant. In the event of a failure occuring during the verification period re-repair will be accomplished until 48 consecutive Failure free hours have accumulated.

11.0 COUNTING OF FAILURES: Any independent (primary) failure discovered during the failure analysis shall be counted as a separate failure for the purpose of computing the DMTBF. However, any dependent (secondary) failure resulting from an independent (primary) failure will not be counted as a separate failure if the dependent failure is verified at the same time as the independent failure.

12.0 RECORD OF EVENTS AND TEST TIME: A test log will be kept for each transceiver. All events and times pertaining to each transceiver which have a bearing on establishing the time of failure and determining the test time will be recorded in the test log.

12.1 TIME OF FAILURE: Time of failure shall be recorded as the moment in time that an indication of failure was recorded on the test monitoring equipment, whether or not the verified failure is the same as the indicated failure. If a failure is discovered and verified when there was no indicated failure recorded by the test monitoring equipment, the time of failure will be the moment in time that the failure was discovered.

12.2 TEST TIME: Test time is the period of accumulated time the unit is under test except for time out for failures (i.e., the period of time between the time of failure and the time that the unit was put back under test). Official accumulation of test time for each transceiver will begin when the transceiver is placed into test after the pre-test checkout specified in paragraph 6.1 of this test plan. Test time will accumulate until the time a verified failure occurs on the transceiver or until the end of the test period in the event that there is no failure. Test time will continue to accumulate after the failed unit is restored to operation and placed back under test. If a failure is verified, the period of time from occurrence of the failure and the time required to conduct a failure analysis and put the unit back into operational status will not count as test time; if no failure is verified, the time will count as test time. Repair verification time will not be counted as test time.

13.0 DETAILED TEST PROCEDURES: Detailed test procedures necessary to implement this test plan are contained in Appendixes I and II.

DMTBF TEST SET OPERATION

1. SCOPE This document outlines the general operation of the DMTBF Test Configuration.

1.1 The AN/GRC-171 Automatic Test Equipment (ATE) is designed to perform three primary functions. First, the ATE will provide control of the 30 transceiver test samples. This control will include keying signals, automatic frequency channeling, and a variety of modulation sources. The second function is to measure and record transmitter unmodulated RF power and frequency, and receiver audio output. Along with time of day, these three parameters will be recorded on a model 37 teletype. The final function is the monitoring of the three parameters to verify the transceivers are still operating within acceptable limits. When a potential failure occurs, the current status will be printed out and flagged. It must be emphasized that this test set will not confirm a failure, this must be accomplished manually by the test team.

2. THEORY AND OPERATION

2.1 The ATE is controlled by timing pulses produced by an ATCC 3000 digital clock. A Master Control Unit (MCU) divides and gates these pulses to provide the appropriate control pulses to two primary stepping relays which are used to determine test phase.

2.1.1 The cycling of the back-to-back transceiver pairs is divided into four, three minute phases. The following conditions are applied to the transceivers:

Phase 0: Odd numbered transceivers transmit unmodulated signal while even numbered transceivers receive. ATE measuring equipment will monitor odd transceivers RF power and frequency.

Phase 1: Odd transceivers transmit modulated signal while even transceivers receive. ATE monitors even transceivers audio output.

Phase 2: Even numbered transceivers now transmit unmodulated signal while odd numbered transceivers receive. ATE measuring equipment will monitor even transceivers RF power and frequency.

Phase 3: Even transceivers transmit modulated signal while odd transceivers receive. ATE monitors odd transceivers audio output.

2.1.2 Each phase is subdivided into 15 steps. The pulse controlled stepping switches will connect the proper transceiver output to the appropriate measuring devices. For example, during Phase 0, step 1, the RF output of transceiver #1 is routed to the frequency counter and

power meter. During step 2, the RF output of transceiver #3 is routed, and so on. This process is duplicated for receiver measurements by a DVM during Phase 1. At the end of Phase 1, the transceivers pair keying is changed and the process described above is repeated. The transceiver pairs will run through these phase cycles five times per hour.

2.2 The operating frequencies of the transceiver pairs are automatically changed every hour with a minimum of 7 MHZ separation between transceiver pairs. The frequencies of the transceivers are measured during Phases 0 and 2.

2.3 Hard copy printouts of time of day, phase and transceiver, RF power, frequency and receiver audio output will be made hourly. In addition, digital comparators will be used to monitor pre-set tolerance limits and deviations will result in hardcopy printouts for the affected transceivers. These printouts (both routine and flagged) will be used to monitor transceiver performance and indicate possible failures.

2.4 The temperature in the vicinity of each transceiver will be continuously monitored. In the event of a temperature exceeding 42° C the ATE will automatically shut down and the transceivers will revert to receive mode of operation.

2.5 REMOTE CONTROL UNITS A separate test configuration shall be constructed to apply power to the remote control units of each transceiver. The control units will remain energized for the duration of the test except when being subjected to bench tests. Each control unit will be exercised every two days by using it with its associated transceiver during the transceiver's daily bench tests.

3. ADDITIONAL TESTS In addition to normal test set operation, the following additional tests will be conducted to monitor transceiver performance and parameters.

3.1 A pre-test checkout will be conducted by the test team under the direction of the Sacramento ALC Service Engineering Test Director. This test will be used to varify proper transceiver operation before start of testing. This same test will be used for the daily bench test as described in 3.1.2 of this document.

3.1.2 A daily bench test will be conducted on all transceivers under test each duty day until test completion. A detailed test plan is included in Appendix II.

4. PERSONNEL Only test team personnel directed by the test director will be allowed to operate the ATE, accomplish bench tests, pre-test checkouts, or verify failures. Contractor representatives may assist at the discretion of the Test Director.

DMTBF BENCH TEST PROCEDURES

1.0 SCOPE This document outlines the procedures to be used, in addition to the DMTBF Test Configuration, to monitor the performance of AN/GRC-171 units under test.

2.0 PURPOSE The purpose of these tests will be to monitor AN/GRC-171 performance and provide data on unit degradation during the entire test period. Each unit will be tested prior to installation in the test configuration. In addition, all units under test will be manually tested on a daily basis (excepting Saturdays, Sundays, and Holidays) throughout the test period. These units shall be tested in accordance with the procedures outlined herein. Data accumulated from these tests will be recorded and logged. At the completion of the test period, all units will again be subjected to these tests. All failures detected during this period will be considered verified failures in accordance with the requirements outlined in the test plan for simulated operational test of AN/GRC-171 transceiver, para 9.1. The data acquired from these tests will be used to analyze AN/GRC-171 long term performance and detect failures.

3.0 TEST TIME All units will be subjected to the bench test by the test team on a daily basis for the duration of the DMTBF test. The transceivers will not be removed from the test racks during these tests.

4.0 TEST SET-UP See Figure 1.

5.0 LOCAL/REMOTE OPERATION Each unit under test will be alternately operated in the local and remote modes. The normal cycle will be one working day in the local mode followed by one working day in the remote mode throughout the test duration. An indication of which mode was used will be indicated in the test log.

6.0 TEST PROCEDURE

6.1 RECEIVER SENSITIVITY Input an RF signal at 225.000 MHz at a level of 6 UV (open circuit) modulated 30% with a 1 KHz audio signal. Connect the power meter to the main audio output. Set the main audio gain control for 120 MW output. With the test unit at the correct channel, set the audio analyzer to a reference level. Measure and record the audio power and S+N/N. Repeat the measurements for channel frequencies of 300.000 and 399.975 MHz but do not readjust the audio power output ateach setting. The power level shall be not less than (NLT) 20 dbm and the S+N/N ratio shall be NLT 10 db.

- CAUTION -

DISCONNECT RF GENERATOR AND CONNECT RF LOAD PRIOR TO PERFORMING TRANSMITTER TESTS

6.2 TRANSMITTER POWER OUTPUT Remove the audio input signal. Key the transceiver. Measure and record the power output at a radio channel frequency of 225.000 MHz. Repeat the above for channel frequencies of 300.000 and 399.975 MHz. The power output will be NLT 16.0 watts and not more than (NMT) 31.8 watts.

6.3 FREQUENCY ACCURACY Set the audio input to 0 volts and the transceiver on the 225.000 MHz channel. Key the transceiver. Measure and record the RF carrier frequency. Repeat the measurements for channel frequency of 300.000 and 399.975 MHz. The frequency will be within ± .0005% of the channel frequency.

6.4 Input an audio signal of 0.25 VRMS at a frequency of 1000 Hz. Set the radio channel selector to 300.000 MHz. Adjust the % modulation control for 90% modulation on the front panel meter. Set the local oscillator 5 MHz above transceiver frequency. Measure % modulation on oscilloscope and record. Repeat the above steps for transceiver frequencies of 300.000 MHz and 399.975 MHz. Do not readjust modulation control. The modulation percentage shall be between 81% and 99%.

6.5 BITE Read and record the appropriate front panel meter reading and the test point voltages under the operating condition specified below at a channel frequency of 300.000 MHz unless otherwise specified below.

WITH NO MODULATION AND TRANSMITTING:

Testpoints:			METER:	
	PA	FWD		FWD PWR
	PA	REF		RFD PWR
	ALC			TEMP
	KEY			+26
				+23
				+12
				+ 5
				-12

WITH 90% MODULATION (1 KHz AUDIO SIGNAL) AND TRANSMITTING:

Testpoints: XMIT Audio METER: % MOD

RECEIVER MODE: INPUT A 30% MODULATED 6 UV (OPEN CIRCUIT) RF SIGNAL:

Testpoints:
SERVO +
SERVO -
Tune Volt (Channel frequency 312.500 MHz)
PLL out
PLL Fault
IF AGC
RCV Audio

The limits for each reading shall be as specified on the data sheet. Be sure the losses and calibration of the measuring instruments are taken into account for the meter power and modulation limits.

AN/GRC-171 BENCH CHECK
DATA SHEETS

6.1 RECEIVER SENSITIVITY

TEST FREQUENCY	MAIN AUDIO	S+N/N	LIMIT S+N/N
225.000	____	____	NLT 10 dB
300.000	____	____	
399.975	____	____	AUDIO NLT 20 dBM

6.2 TRANSMITTER POWER OUTPUT

TEST FREQUENCY	POWER OUTPUT WATTS	LIMIT
(MHz)		NLT 16 WATTS
225.00	____	NMT 31.8 WATTS
300.00	____	
399.975	____	

6.3 FREQUENCY ACCURACY

TEST FREQUENCY	RF CARRIER FREQUENCY	LIMIT
(MHz) 225.00	_____	+ .0005% OF TEST FREQUENCY
300.00	_____	
399.975	_____	

6.4 MODULATION PERCENTAGE

TEST FREQUENCY	MODULATION PERCENTAGE	LIMIT
(MHz)	%	
225.000	_____	81 - 99%
300.000	_____	
399.975	_____	

6.5 BITE

METER

TEST CONDITION	POSITION	READING	LIMIT
TRANSMIT NO MODULATION	FWD PWR	_____W	±10% OF 6.2 ABOVE
TRANSMIT NO MODULATION	RFD PWR	_____W	
TRANSMIT 90% MODULATION	% MOD	_____%	±10% OF 6.4 ABOVE
TRANSMIT NO MODULATION	+26	_____V	24.5V TO 27.5V
TRANSMIT NO MODULATION	+23	_____V	20.5V TO 23.5V
TRANSMIT NO MODULATION	+12	_____V	11.0V TO 13.1V
TRANSMIT NO MODULATION	+ 5	_____V	4.6V TO 5.6V
TRANSMIT NO MODULATION	-12	_____V	-11.0 TO -13.1V

TEST POINTS

TEST CONDITION	TEST POINT	VOLTAGE(V)	LIMIT
TRANSMIT NO MODULATION	PA FWD	_____	0.5 TO 1.2V
TRANSMIT NO MODULATION	PA RFD	_____	-0.2 TO 0.3V
TRANSMIT NO MODULATION	ALC	_____	0.5 TO 2.5V
TRANSMIT NO MODULATION	KEY	_____	0.05 TO 0.5V
TRANSMIT 90% MODULATION	XMIT AUDIO	_____V RMS	0.6 TO 1.1V
RECEIVE -30% MODULATED SIGNAL	SERVO+	_____	0.0 TO 6.5V
RECEIVE -30% MODULATED SIGNAL	SERVO-	_____	0.0 TO 6.5V
RECEIVE -30% MODULATED SIGNAL	TUNE VOLT	_____	0.1 TO -0.1V
RECEIVE -30% MODULATED SIGNAL	PLL OUT	_____	0.2 TO 1.5V
RECEIVE -30% MODULATED SIGNAL	PLL FAULT	_____	2.0 TO 5.0V
RECEIVE -30% MODULATED SIGNAL	IF AGC	_____	-0.3 TO -0.7V
RECEIVE -30% MODULATED SIGNAL	RCV AUDIO	_____V RMS	0.16 TO 0.3V

Attachment 1

J - Guaranteed Demonstrated Mean Time Between Failure (DMTBF)

I. Definition

A. Guaranteed DMTBF is defined as the ratio of total operating hours to the total number of failures. Computation of the DMTBF shall be accomplished by use of the following formula:

$$\text{DMTBF} = \frac{\text{Total Operating Hours At Completion of Testing}}{\text{Total Number of Failures At Completion of Testing}}$$

B. Total Operating Hours is defined as the total time recorded by installed Elapsed Time Indicators (ETI) on each of the test units for the test period of time specified herein, less any time out for failures as indicated by the Government monitoring equipment and test log record.

1. ETI's will be installed by Government personnel.

2. Government personnel will install the units and certify that they are ready to be operated in accordance with the Test Plan specified in H.1. below.

3. Government personnel will operate the units undergoing test. The contractor will perform adjustment, repair, replacement, or maintenance and provide material support as requested by the Government, at no increase in contract price.

4. The contractor is required to have a representative present during normal duty hours of the Demonstration Test for the purpose of observing performance, at no increase in contract price.

C. The total Number of Failures for the purpose of this DMTBF computation is defined as the total numerical count of only those failures certified by the Procuring Contracting Officer (PCO) as being relevant. The contractor may submit to the PCO any evidence in an attempt to prove that a failure should not be considered a relevant failure.

D. Unit

For the purpose of this clause, a unit is defined as the UHF AM Transceiver, AN/GRC-171 supplied as Item 1 under this contract.

E. Failure

1. For the purpose of this clause only, a failure in the unit is defined as any malfunction which requires adjustment, repair, replacement, or maintenance in order to restore the unit to an operational status as defined in Paragraph I.E.3. below.

2. Except for the following, any failure in a unit will be considered relevant for the purpose of computing the DMTBF:

   a. Failure or loss of electrical power source to the unit or within the power supply cord.

   b. Failure of test instrumentation or monitoring equipment that is external to the unit.

   c. Failure caused by damage resulting from external accident.

   d. Failure caused by improper operation or maintenance by Government personnel.

3. Operational Status of a unit is defined as operation of that unit in accordance with the requirements established by the OCAMA Technical Exhibit OCNEE 66-69A dated 18 October 1967 and clarifications pertaining thereto (Reference Attachment 1 of OCAMA Letter Request for Technical Proposals dated 29 September 1971).

F. Test Units

Test Units will consist of 30 each AN/GRC-171 units selected at random by the Government from the first three months production quantity. 11 units will be selected from each months production. Test will be accomplished on each lot of 10 units received with

the 11th unit as a backup in case of failure. In the event the backup unit fails and cannot be repaired, the Government has the option of selecting additional production units to add as test units.

G. Location

1. The demonstration of DMTBF shall be accomplished in the OCAMA Engineering Test Laboratory, Tinker AFB, Oklahoma 73145.

2. Notification by the PCO will be provided to the contractor at least 30 days prior to the scheduled demonstration test start date.

H. Test Criteria

1. The demonstration of DMTBF will be accomplished in the OCAMA Engineering Test Laboratory under simulated Air Traffic Control operational environments as specified in OCAMA Test Plan MMES 72-1, dated 18 Jan 72, attached hereto.

2. Test Units will operate 24 hours a day, 7 days a week.

3. The units undergoing test will be monitored by Government personnel during normal duty hours, 40 hours per week. Units failing during non duty hours will be reviewed during the next regular duty shift to determine the relevancy of the failure.

4. In the event the PCO determines that a unit cannot be returned to serviceable condition after a failure, a backup unit will be substituted in its place.

II. Testing Period

Each of the first two lots of 10 units will begin testing following installation and checkout, and continue for a period not to exceed the last day of the period established for the third lot. The third lot will be tested for a period of 5,000 calendar hours. For example, a third lot of 10 units starting test at 0800 hours, 1 Jan 72 would terminate the testing period for all 30 units at 1600 hours, 26 Jul 72.

III. DMTBF Adjustments

A. No adjustments will be made, pursuant to the terms of this clause, to the contract unit price of the quantity designated as the basic quantity. However, all the other terms and conditions of the contract are applicable to the basic quantity.

B. At the completion of the demonstration and computation of the DMTBF as stated in I.A. above, the contract unit price for Option I and Option II shall be adjusted as hereinafter set forth.

C. Adjustment will be made in accordance with the following equations:

1. If the demonstrated-mean-time-between-failure (DMTBF) is equal to or greater than 1000 hours and less than 1625 hours then the cost adjustment (CA) downward for each test unit shall be:

$$CA = \$1,748 - \frac{87600 \text{ Hours } (\$33.31)}{DMTBF} \quad \text{or}$$

$$CA = \$1,748 - \frac{\$2,917,956 \text{ Hours}}{DMTBF}$$

$1,748 is the 10 year cost of repairing equipment with a 1667 hour MTBF, 87,600 is ten years converted to hours and $33.31 is the estimated cost per failure.

2. If the DMTBF is less than 1000 hours the Government does not intend to exercise any options.

3. If the DMTBF is equal to 1625 hours and less than or equal to 1709 hours, no cost adjustment shall be made.

4. If the DMTBF is greater than 1709 hours and less than or equal to 5000 hours, the cost adjustment (CA) upward for each unit shall be:

$$CA = P \left[\$1,748 - \frac{87600 \text{ Hours } (\$33.31)}{DMTBF} \right] \quad \text{or}$$

$$CA = P \left[\$1,748 - \frac{\$2,917,956 \text{ Hours}}{\text{DMTBF}} \right]$$

Where $1,748 is the 10 year cost of repairing equipment with a 1667 MTBF, 87,600 is ten years converted to hours, $33.31 is the estimated cost per failure, and P is the weighting factor applied to the cost savings.

The value of P to be used in the calculation of CA for a DMTBF greater than 1709 hours and less than or equal to 5000 hours shall be obtained from the following table:

P	Q
.90	6.304
.80	7.807
.75	8.438
.70	9.034
.50	11.340
.30	14.011
.25	14.845
.20	15.812
.10	18.549

Where Q is a factor defined by the following equation:

$$Q = \frac{5000 \text{ Hours}}{\text{DMTBF}} \quad X \quad 6.304$$

For calculated values of Q less than or equal to 18.549 and greater than or equal to 6.304, the value of P, corresponding to the calculated Q, will be used. For calculated values of Q not listed in the table, linear interpolation will be used to arrive at the correct value of P.

5. For a DMTBF greater than 5000 hours, the adjustment will be based on a DMTBF equal to 5000 hours and P will equal .9.

IV. Examples of Clause Operation

A. For these examples only 3 units will be used in lieu of the 30 called for by the clause.

B. Assumed unit price of successful contractor is $4,784.20.

1. Upward Price Adjustment

Assumed results of actual demonstration:

Unit	Failures	Operating Hours
1	2	6,000
2	3	5,500
3	2	2,000*
4	1	3,000
Totals	8 Failures	16,500 Hours

*Unit cannot be returned to service and provisions of Paragraph I.H.4. are applied.

Formula application from Paragraph I.A.

$$\text{DMTBF} = \frac{16{,}500 \text{ Hours}}{8 \text{ Failures}} = 2{,}062.5 \text{ Hours}$$

Adjustment per equation in Paragraph III.C.4. is:

$$\text{CA} = P \left[\$1{,}748 - \frac{\$2{,}917{,}956 \text{ Hours}}{2{,}062.5 \text{ Hours}}\right] \text{ or}$$

$$\text{CA} = P \left[\$1{,}748 - \$1{,}415\right] \text{ or } \text{CA} = P \left[\$333\right] \text{ and}$$

$$Q = \frac{5000 \text{ Hours}}{2{,}062.5 \text{ Hours}} \times 6.304 = 15.282$$

By linear interpolation from Table P = .227 which results in $75.59 increase added to contract unit price prior to adjustment of $4,784.20 which equals an adjusted unit price of $4,859.79.

2. Downward Price Adjustment

Assumed results of actual demonstration:

Unit	Failures	Operating Hours
1	5	6,000
2	4	5,500
3	4	5,000
Totals	13 Failures	16,500 Hours

Formula application from Paragraph I.A.

$$DMTBF = \frac{16500 \text{ Hours}}{13 \text{ Failures}} = 1269.2 \text{ Hours}$$

Adjustment per equation in Paragraph III.C.1. is

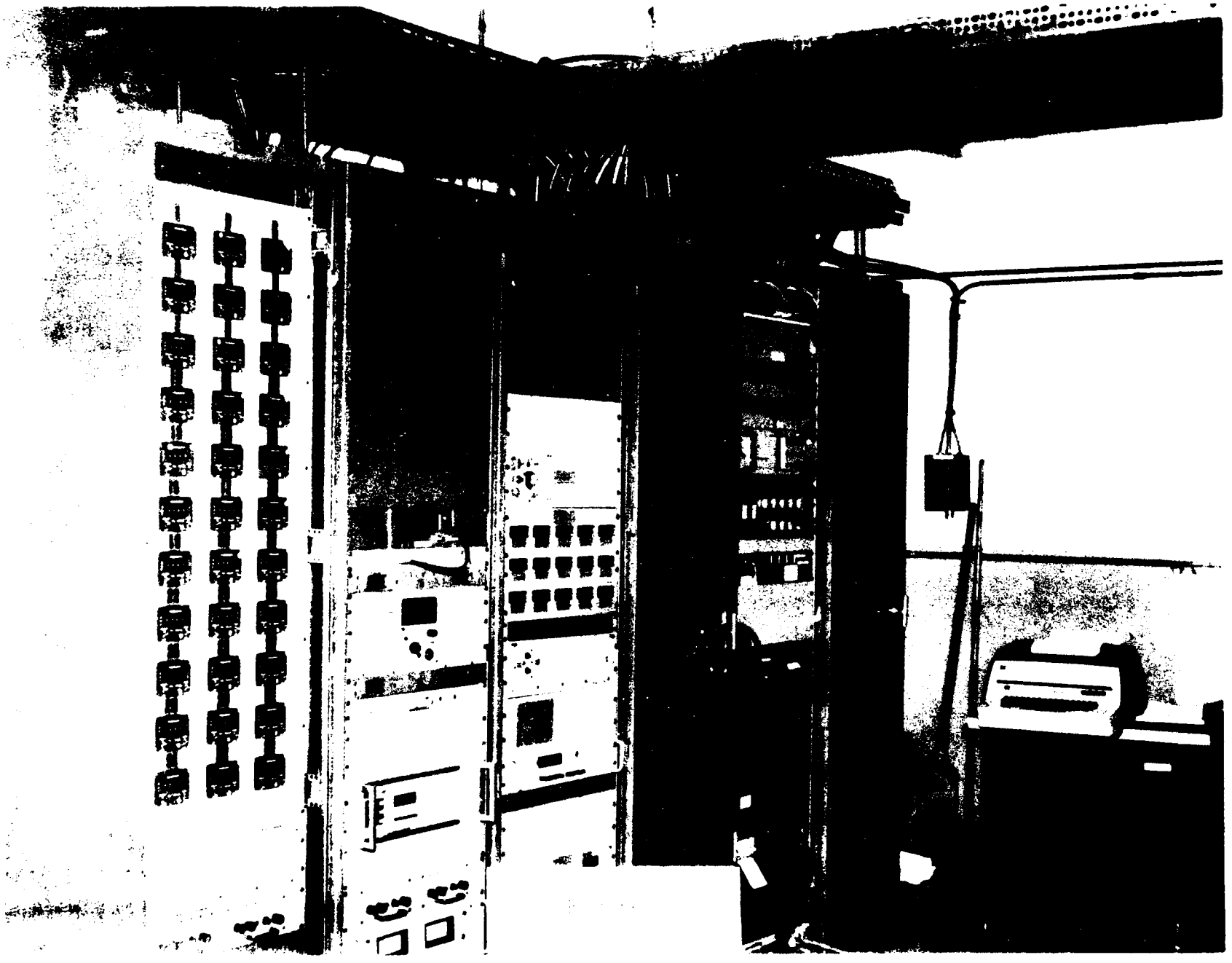
$$CA = \left[\$1{,}748 - \frac{\$2{,}917{,}956 \text{ Hours}}{1269.2 \text{ Hours}}\right] \text{ or}$$

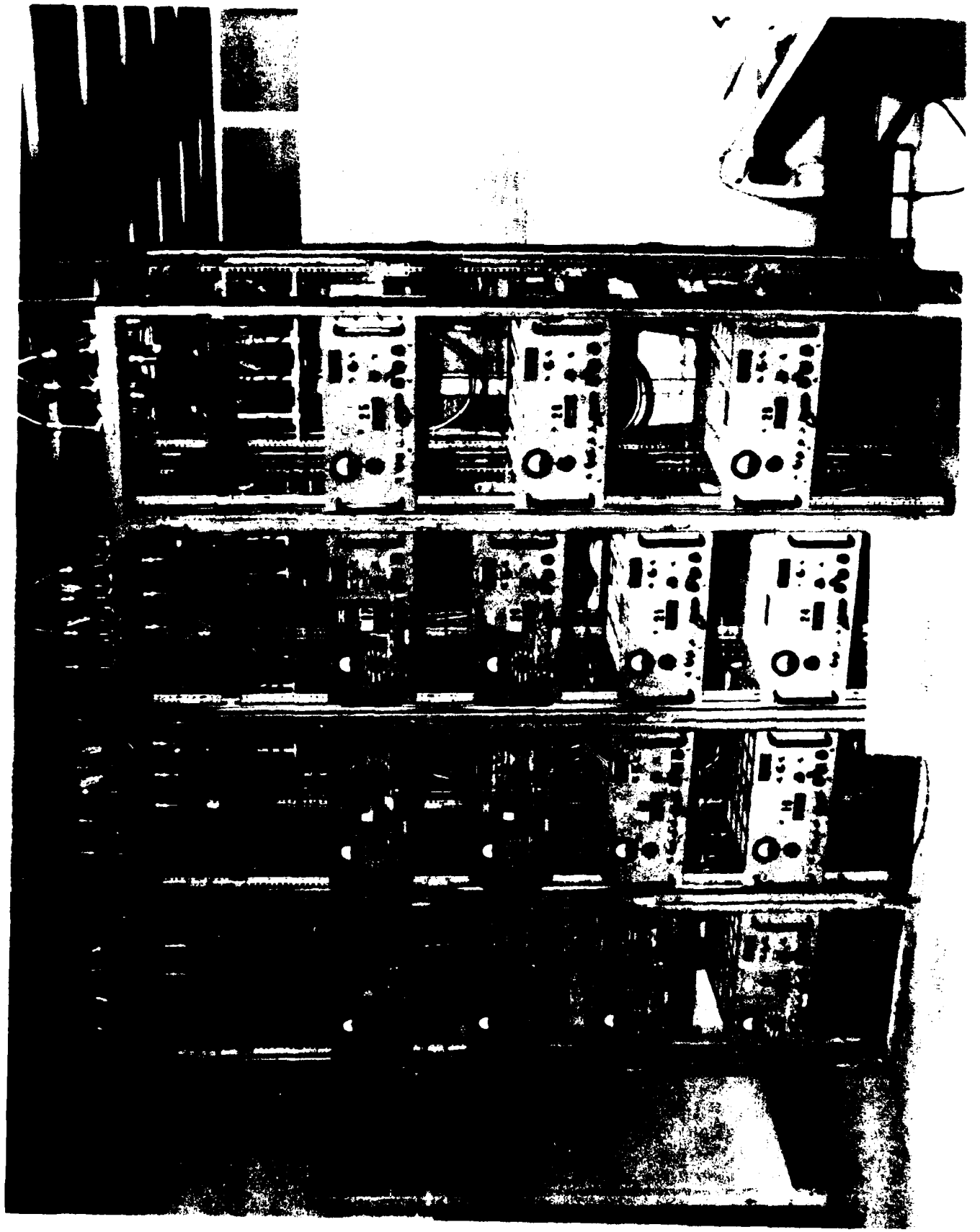
$$CA = \left[\$1{,}748 - \$2299.1\right] \text{ or } CA = -\$551.10.$$

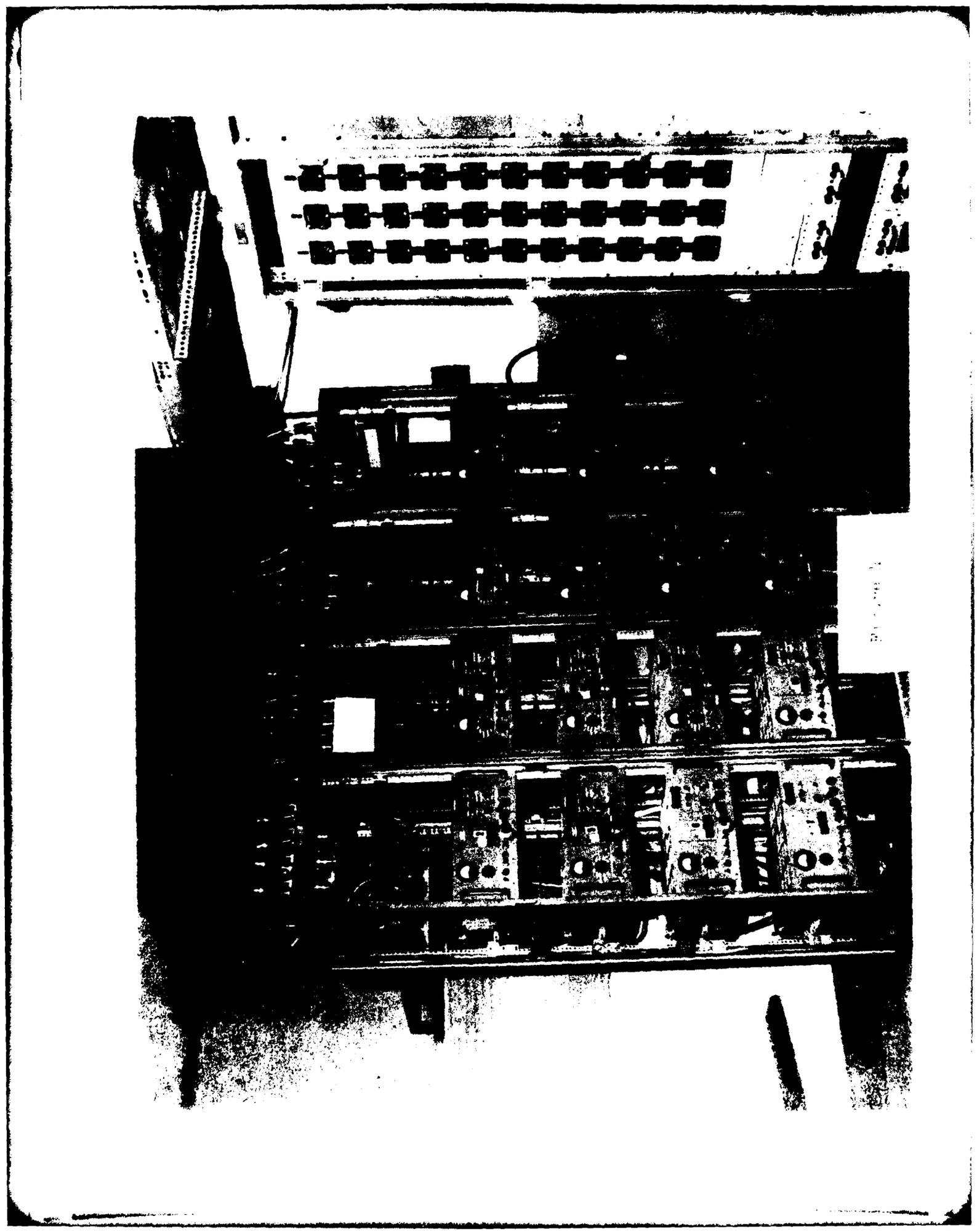
This adjustment of the unit price of $4,784.20 would equal an adjusted unit price of $4,233.10.

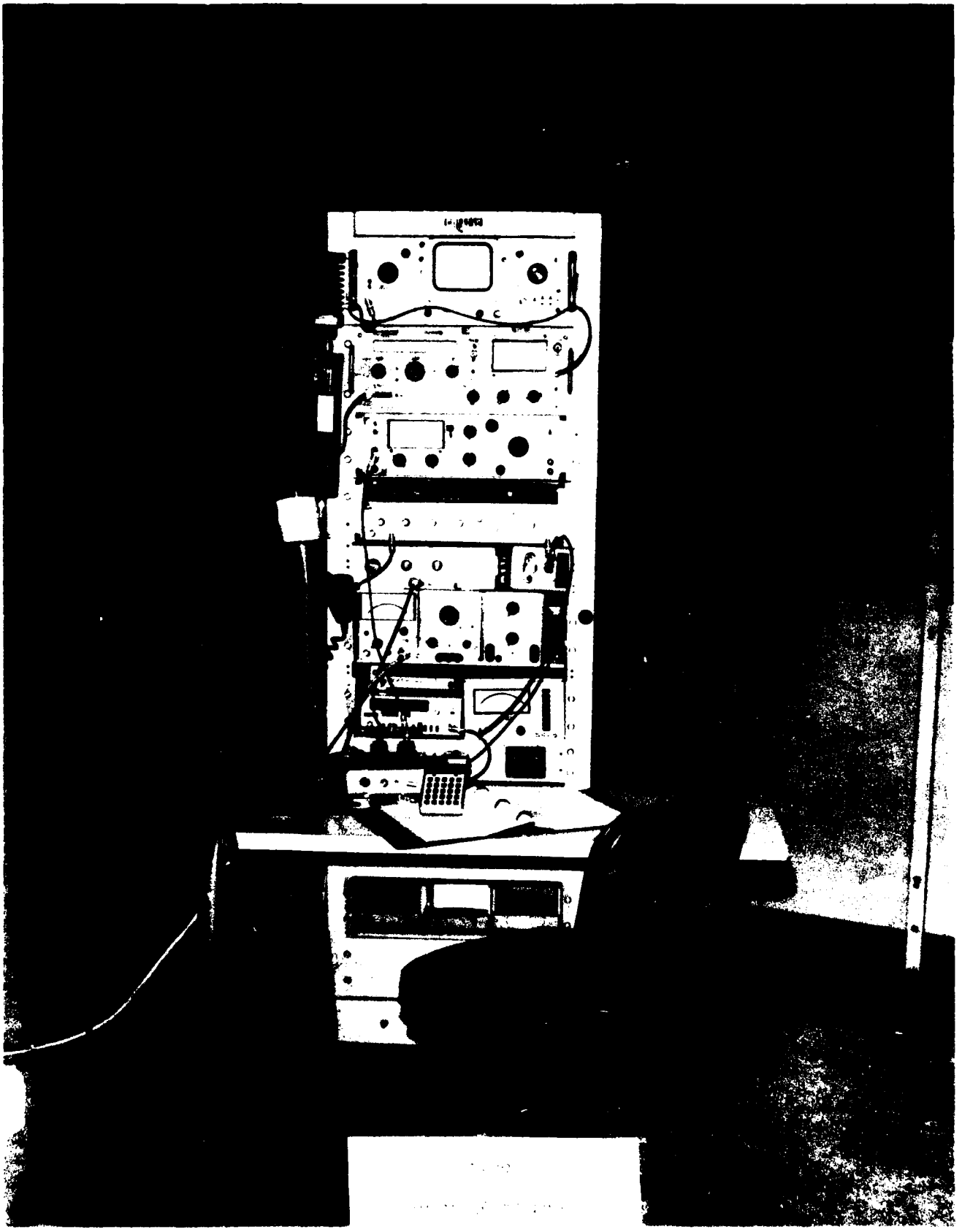
V. Determinations

Any disagreements arising under this clause entitled "Guaranteed Demonstrated Mean Time Between Failure (DMTBF)" shall be resolved by the Procuring Contracting Officer. Any decisions or determinations by the Procuring Contracting Officer under this clause shall be final and shall not be subject to the "Disputes" clause of this contract.









4. TEST RESULTS

4.1 Installation: Radios were divided into two groups of fifteen, odd and even numbered. The radios were then installed in equipment racks as shown in Figures 3 and 4. Standard GRC-171 slides and connectors were used. Remote cables necessary to interface the radios to the ATE were manufactured and installed by test personnel. Equipment cabinets were originally completely enclosed with blower fans installed for cooling. This configuration would not meet the temperature requirements as called out in Para 7.1 of the test plan. The cabinets were then stripped and two large floor fans used for air circulation. Thermocouples were installed approximately two inches above the center of each radio to monitor temperature.

4.2 Start Dates

4.2.1 Lot #1: The first month's production sample arrived in late August. They were bench checked prior to installation and testing began on 22 Sep 1975 at 1200 hrs.

4.2.2 Lot #2: The second month's sample arrived in early October. They were bench checked and began testing on 3 Oct 1975 at 1230 hrs.

4.2.3 Lot #3: The final sample lot arrived in mid November. They were bench checked and began testing on 18 Nov 1975 at 1300 hrs. DMTBF testing ended 5,000 calendar hours from the start of the last sample which brought test completion on 13 Jun 1976 at 2100 hrs.

4.3 Test Time: Pertinent facts relating to DMTBF test time and total operating hours are listed in the following tables.

10 Radios Per Lot	Start Date	Total Lot Hours To Test End	Actual Hours Tested
Lot 1	22 Sep 75	63,690	62,941.2
Lot 2	3 Oct 75	61,045	60,177.1
Lot 3	18 Nov 75	50,000	49,852.7
		174,735 Total	172,971 Total

Table I

Total non-operating time due to power outage, radio failure or daily bench check was 1,764 hours. Total times accumulated on each radio are listed in Table II.

Operating Time For Each Transceiver

Radio Lot 1	ETM Total	Radio Lot 2	ETM Total	Radio Lot 3	ETM Total
1	6314.0	11	6031.5	21	4987.4
2	6308.8	12	6030.4	22	4988.2
3	6308.5	13	6002.7	23	4988.9
4	6306.8	14	6005.4	24	4988.6
5	6286.3	15	5995.8	25	4972.3
6	6285.4	16	6030.7	26	4988.5
7	6273.2	17	6010.9	27	4986.9
8	6283.0	18	6011.2	28	4975.4
9	6288.3	19	6029.4	29	4989.9
10	6286.5	20	6029.3	30	4987.6
	62,941.2		60,177.1		49,852.7
		Spare Radios			
31	0.2	32	2.0	33	0.1

FAILURES

Failure No.	Radio	Serial No.	Module	Time of Failure (hrs)	Failure Analysis
1	7	34	DC-DC	154	F-1
2	15	184	DC-DC	37	F-2
3	14	192	Audio	74	F-3
4	3	87	Freq Synth	538	F-4
5	9	59	Freq Synth	536	F-5
6	28	263	Audio	3	F-7
7	17	142	DA-Servo	1046	F-6
8	17	142	Carrier Test Switch	1046	F-9
9	15	184	DC-DC	2896	F-32
10	8	54	P.A.	3854	F-45

Table III

4.3.1 Non-Relevant Time: A total of 881.3 hours non-relevant test time was logged during the test. This time is the result of failure repair verification on failed modules.

4.3.2 Calculated DMTBF: The calculated DMTBF based on the relevant failures and 172,092 equipment operating hours is 17,209.2. This figure excludes all non-relevant failures, non-relevant test time and does not include any failures generated as a result of C-7999 control unit panel lamp and ready lamp failures. It was necessary to restart the 5,000 hour test on the C-7999 due to modifications incorporated to improve panel lamp and ready lamp reliability during the test period. This test, which is scheduled for completion on 23 Nov 1976, will provide additional failure data on the panel and ready lamps only. Testing of all other aspects of the control units was completed during the basic test period. The DMTBF figure will be modified by any additional relevant failures generated during the retest period.

4.4 Failures and Failure Analysis: A total of ten relevant failures occurred during DMTBF testing. A brief synopsis of each failure is listed below. Collins Radio failure analysis are included for reference.

a. Failure No. 1: This failure occurred on 29 Sep 75 at 0214 hours. The failure was on radio number 7 (serial No. 34) after 154.3 operating hours. Test personnel arrived at 0700 hours the same day and discovered an ATE alarm on radio position No. 7. Visual indication was a blown AC fuse (A10A1F2). Radio was removed from test and subjected to the troubleshooting procedures of T.O. 31R2-2GRC171-2. The AC line fuse was replaced and power was restored. The radio began to smoke in the vicinity of the DC-DC convertor-module. The convertor was replaced and the radio was rechecked. The radio was returned to test using the spare DC-DC convertor. The failed module was returned to Collins Radio for analysis and repair. Following repair, the failed module was returned to test in radio No. 7.

b. Failure No. 2: This failure occurred on 4 Oct 75 at 2229 hours. The failure was on radio No. 15 (S/N 184) after 37.2 operating hours. The ATE was in standby due to a relay synchronization problem and all radios were in receive. The ATE was reset and then testing resumed On keying, radio No. 15 failed. The ATE began alarming on power and frequency readings. Radios' meter indications showed a loss of +5 and -12 volt supplies. Analysis indicated a failure in the DC-DC convertor. The defective module was replaced and returned to Collins for repair and analysis. Following repair the module was returned to test in radio No. 15.

c. Failure No. 3: This failure occurred on 7 Oct 75 at 0423 hours. This failure was on radio No. 14 (S/N 192) after 67 operating hours. The ATE began alarming radio position No. 14, indicating no receiver audio output. The radio was removed to the bench where it was determined that the squelch was not functioning. The audio module (A4) was replaced and returned to the factory for analysis and repair. The module was returned to test in radio 14.

d. Failure No. 4: This failure occurred on 16 Oct 75 at 1300 hours. It was on radio No. 3(S/N 87) which had 538.4 hours. During a daily bench check, maintenance technicians found that they could not get a ready light at 225 MHz in the receive mode, when the radio was keyed however, the ready light came on. The T.O. troubleshooting procedure was used to determine that the frequency synthesizer (A2) had failed. The board was returned to Collins for repair and analysis prior to reinstallation in radio No. 3.

NOTE: The ATE controlled the test radios by remote lines; therefore, the RT-980 local ready lights (DS-1) were normally off except when the radios were subjected to bench checks under local control.

e. Failure No. 5: This failure occurred on 17 Oct at 1102 hours. Radio No. 9 (S/N 59) failed after 535.5 operating hours. As a result of failure No. 4 all test radios were placed in local and set to frequencies of 225 MHz to check the ready lights. During this procedure radio No. 9 ready light would not function at the low frequency. As in failure No. 4 the frequency synthesizer was removed and returned to Collins for analysis and repair. Upon repair the module was returned to test in radio No. 9.

f. Failure No. 6: This failure occurred shortly after initial installation of the final lot of radios. Radio No. 28 (S/N 263) failed on 18 Nov 75 at 1613 hours after 3 operating hours. The ATE began alarming radio position No. 28 indicating no receiver audio output. The radio was bench checked and failure of audio module (A4) was confirmed. The module was replaced and returned to Collins for repair and analysis. The module was returned to test in radio No. 28 following repair.

g. Failure No. 7 and 8: These failures were discovered on the 18th and 19th of Nov 75, and are included together because they were both on the same radio. The failed radio was No. 17 (S/N 142) which had 1046.3 operating hours. While the test team was completing failure verification on failure No. 6 radio No. 17 began to smoke heavily from the vicinity

of the voltage regulator. Power was cut and the radio bench checked. Visual indications were of large charred areas on the DA servo board and the voltage regulator board. Both modules were replaced and the radio bench checked prior to resumption of testing on the 19th of Nov. While keying locally, the radio would key intermittently. The carrier test switch was replaced and the radio bench checked and returned to test. Failure analysis indicated an initial failure in the DA servo with a secondary failure in the voltage regulator. This was failure No. 7. Failure No. 8 was the carrier test switch which was a separate component failure. The DA servo and voltage regulator boards were reinstalled following repair. The carrier test switch was non-repairable and was replaced.

h. Failures 9 through 38 with the exception of failure No. 32 are non-relevant failures. These failure numbers were assigned to panel, ready, and power on lights. The explanations of failure relevancy of these components are included later in this report.

i. Failure No. 32: This failure occurred on 5 Feb 76 at 1405 hours. Radio No. 15 (S/N 184) failed after 2896.2 operating hours. The ATE began alarming on power and frequency measurements. The radio panel meter indicated loss of +5 and -12 volt supplies. The T.O. troubleshooting procedure indicated a failure in the DC-DC convertor. The module was replaced and returned to Collins for analysis and repair. This was the second failure of this DC-DC convertor. Following repair the module was returned to test in radio No. 15.

j. Failure No. 45: This failure occurred on 4 Mar 76 at 1300 hours. Radio No. 8 (S/N 54) had a total of 3854.2 operating hours at the time of failure. While the radio was under automatic testing, test personnel noticed the radio meter indicating overmodulation. The radio meter would indicate correctly and then begin to "hunt" across the scale. The radio was bench checked and indicated the same problem. The P.A. was replaced and returned to Collins for analysis and repair prior to resuming testing. The P.A. was returned to test in radio No. 8 following repair.

FAILURE ANALYSIS REPORT

COLLINS RADIO COMPANY

FAILURE REPORT NO F-1

DATE 2 Mar. 76

GENERAL DATA

UNIT TYPE NO GRC-171 UNIT PART NUMBER 622-1628-001

UNIT SERIAL NO 34 UNIT CONTRACTOR

FAILURE LOCATION DMTBF FAILURE DATE Sep. 29, 75

AS APPLICABLE

MODULE TYPE NO DC/DC Converter (A5) SERIAL NUMBER MCN 247

CIRCUIT BOARD TYPE NO SERIAL NUMBER

SUB MODULE TYPE NO A1 Control SERIAL NUMBER

FAILED ITEM DESCRIPTION Capacitor (40 kz timing)

COLLINS PART NO 933-1039-130 CIRCUIT SYMBOL NO A1C29

MANUFACTURER Sprague MFGR. P/N 292P2229R8 MFGR. S/N

FAILURE ANALY.

ANALYSIS PROCEDURES AND RESULTS:

ETM at Failure: 154.3

Fail Mode: No voltage

Fail Mechanism: Intermittent capacitance due to corrosion on cap caused change in switching frequency and overheating of parts.

Corrosion caused by freon attacking end seal of cap.

Secondary Failures: Q2, Q3, Q4, Q6
A2Q10,11,12,17, CR1, CR2, CR4, CR5, R5, R6

(ATTACH ADDITIONAL SHEETS AS NECESSARY)

...RENCE CONTROL

CORRECTIVE ACTION REQUIRED & SERIAL NUMBER EFFECTIVITY: *(IF CORRECTIVE ACTION HAS BEEN TAKEN BASED ON PREVIOUS FAILURE ANALYSIS, STATE APPLICABLE FAILURE REPORT NUMBERS)*

284.

ATTACH ADDITIONAL SHEETS AS NECESSARY

APPROVED BY

FAILURE ANALYSIS REPORT
COLLINS RADIO COMPANY

FAILURE REPORT NO F-2

DATE 2 Mar. 76

GENERAL DATA

UNIT TYPE NO GRC-171 UNIT PART NUMBER 622-1624-001

UNIT SERIAL NO 184 UNIT CONTRACTOR

FAILURE LOCATION DMTRF FAILURE DATE Oct. 4. 75

AS APPLICABLE

MODULE TYPE NO DC/DC Converter (65) SERIAL NUMBER MCN 322

CIRCUIT BOARD TYPE NO SERIAL NUMBER

SUB MODULE TYPE NO A2 50 Watt Converter SERIAL NUMBER

FAILED ITEM DESCRIPTION Workmanship - solder short

COLLINS PART NO NA CIRCUIT SYMBOL NO

MANUFACTURER MFGR P/N MFGR. S/N

FAILURE ANALYSIS

ANALYSIS PROCEDURES AND RESULTS:

ETM at Failure: 37.2

Fail Mode: No +5 or -12V

Fail Mechanism: Solder short on Transformer T1 pins 7 and 8. Transformer replaced.

Secondary Failures: A2Q1, Q2 and F1

(ATTACH ADDITIONAL SHEETS AS NECESSARY)

E. ENGINEERING CONTROL

CORRECTIVE ACTION REQUIRED & SERIAL NUMBER EFFECTIVITY: *(IF CORRECTIVE ACTION HAS BEEN TAKEN BASED ON PREVIOUS FAILURE ANALYSIS STATE APPLICABLE FAILURE REPORT NUMBERS)*

(ATTACH ADDITIONAL SHEETS AS NECESSARY)

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FAILURE ANALYSIS REPORT

COLLINS RADIO COMPANY

FAILURE REPORT NO F-3

DATE 2 Mar. 76

GENERAL DATA

UNIT TYPE NO GRC-171 UNIT PART NUMBER 622-1628-001

UNIT SERIAL NO 192 UNIT CONTRACTOR

FAILURE LOCATION DMTBF FAILURE DATE Oct. 6, 75

AS APPLICABLE

MODULE TYPE NO Audio (A4) SERIAL NUMBER MCN 385

CIRCUIT BOARD TYPE NO SERIAL NUMBER

SUB MODULE TYPE NO SERIAL NUMBER

FAILED ITEM DESCRIPTION IC 1558

COLLINS PART NO 351-1071-020 CIRCUIT SYMBOL NO U5

MANUFACTURER Signetics MFGR P/N 1558 MFGR S/N

FAILURE ANALY

ANALYSIS PROCEDURES AND RESULTS

ETM at Failure: 74.0

Fail Mode: No audio out, can't break squelch

Fail Mechanism: IC side B was locked low disabling squelch circuit. Lock condition caused by punchthrough short in oxide layer of IC due to fault in oxide layer.

Secondary Failures: None

(ATTACH ADDITIONAL SHEETS AS NECESSARY)

RENCE CONTROL

CORRECTIVE ACTION REQUIRED & SERIAL NUMBER EFFECTIVITY: *(IF CORRECTIVE ACTION HAS BEEN TAKEN BASED ON PREVIOUS FAILURE ANALYSIS STATE APPLICABLE FAILURE REPORT NUMBERS)*

(ATTACH ADDITIONAL SHEETS AS NECESSARY)

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FAILURE ANALYSIS REPORT

COLLINS RADIO COMPANY

FAILURE REPORT NO F-6

DATE 2 Mar. 76

GENERAL DATA

UNIT TYPE NO GRC-171 UNIT PART NUMBER 622-1628-001

UNIT SERIAL NO 87 UNIT CONTRACTOR

FAILURE LOCATION DMTBF FAILURE DATE Oct. 16, 75

AS APPLICABLE

MODULE TYPE NO Freq. Synth (A2) SERIAL NUMBER ECN 395

CIRCUIT BOARD TYPE NO SERIAL NUMBER

SUB MODULE TYPE NO A1 Low Band VCO SERIAL NUMBER

FAILED ITEM DESCRIPTION VCO Assembly (LRU)

COLLINS PART NO 623-5844-001 CIRCUIT SYMBOL NO A1

MANUFACTURER Collins MFGR P/N 623-5844-001 MFGR S/N

FAILURE ANALY

ANALYSIS PROCEDURES AND RESULTS

ETM at Failure: 538.8

Fail Mode: No ready lite at 225 MHZ, xmit on frequency, no receive.

Fail Mechanism: VCO generating incorrect frequency due to capacitor C6 within assembly. Cap filler material had shrunk causing change in capacitance.

Secondary Failures: None

(ATTACH ADDITIONAL SHEETS AS NECESSARY)

RRENCE CONTROL

CORRECTIVE ACTION REQUIRED & SERIAL NUMBER EFFECTIVITY (IF CORRECTIVE ACTION HAS BEEN TAKEN BASED ON PREVIOUS FAILURE ANALYSIS STATE APPLICABLE FAILURE REPORT NUMBERS)

(ATTACH ADDITIONAL SHEETS AS NECESSARY)

APPROVED BY

FAILURE ANALYSIS REPORT

COLLINS RADIO COMPANY

FAILURE REPORT NO F-5

DATE 2 Mar. 76

GENERAL DATA

UNIT TYPE NO GPC-171 UNIT PART NUMBER 622-1628-001

UNIT SERIAL NO 59 UNIT CONTRACTOR

FAILURE LOCATION DNTRF FAILURE DATE Oct. 17, 75

AS APPLICABLE

MODULE TYPE NO Freq. Synth (62) SERIAL NUMBER

CIRCUIT BOARD TYPE NO SERIAL NUMBER

SUB MODULE TYPE NO A1 Low Band VCO SERIAL NUMBER

FAILED ITEM DESCRIPTION VCO Assembly (LRU)

COLLINS PART NO 623-5844-001 CIRCUIT SYMBOL NO A1

MANUFACTURER Collins MFGR P/N 623-5844-001 MFGR S/N

FAILURE ANALY

ANALYSIS PROCEDURES AND RESULTS

ETM at Failure: 537

Fail Mode: No Ready lite at 225. Xmit OK, no rcv.

Fail Mechanism: VCO detuned at low frequency end due to circuit aging. In Rcv mode this caused incorrect VCO output and loss of lock. In Xmit mode VCO operates at 30 MHZ higher frequency and output was correct.

Secondary Failures: None

(ATTACH ADDITIONAL SHEETS AS NECESSARY)

SERVICE CONTROL

CORRECTIVE ACTION REQUIRED & SERIAL NUMBER EFFECTIVITY (IF CORRECTIVE ACTION HAS BEEN TAKEN BASED ON PREVIOUS FAILURE ANALYSIS STATE APPLICABLE FAILURE REPORT NUMBERS)

FAILURE ANALYSIS REPORT

COLLINS RADIO COMPANY

FAILURE REPORT NO F-

DATE 2 Mar. 76

GENERAL DATA

UNIT TYPE NO 618-171 UNIT PART NUMBER 522-1321-01

UNIT SERIAL NO 142 UNIT CONTRACTOR

FAILURE LOCATION [illegible] FAILURE DATE Nov. 13, 75

AS APP. CABLE

MODULE TYPE NO DA Servo A1, V Reg A6 SERIAL NUMBER DA MCN 226, V Reg MCN 368

CIRCUIT BOARD TYPE NO SERIAL NUMBER

SUB MODULE TYPE NO SERIAL NUMBER

FAILED ITEM DESCRIPTION Workmanship, solder short

COLLINS PART NO CIRCUIT SYMBOL NO

MANUFACTURER MFGR P/N MFGR S/N

FAILURE ANALY

ANALYSIS PROCEDURES AND RESULTS

ETM at Failure: 1046.3

Fail Mode: Smoke coming from A1 & A5 area

Fail Mechanism: Solder short emitter to base on Q19 of DA Servo resulting in high current draw and secondary failures in V Reg.

Secondary Failures:

DA Servo	Q22, Q18, Q20, Q21	CR30, CR31
V Reg.	VR1, C5, C6, R15, R35, R39	

(ATTACH ADDITIONAL SHEETS AS NECESSARY)

RRENCE CONTROL

CORRECTIVE ACTION REQUIRED & SERIAL NUMBER EFFECTIVITY (IF CORRECTIVE ACTION HAS BEEN TAKEN BASED ON PREVIOUS FAILURE ANALYSIS STATE APPLICABLE FAILURE REPORT NUMBERS)

(ATTACH ADDITIONAL SHEETS AS NECESSAR

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FAILURE ANALYSIS REPORT

COLLINS RADIO COMPANY

FAILURE REPORT NO F-7

DATE 2 Mar. 76

GENERAL DATA

UNIT TYPE NO GRC-171 UNIT PART NUMBER 622-1628-001

UNIT SERIAL NO 263 UNIT CONTRACTOR

FAILURE LOCATION DMTBF FAILURE DATE Nov. 18, 75

AS APPLICABLE

MODULE TYPE NO Audio (A4) SERIAL NUMBER MCN 485

CIRCUIT BOARD TYPE NO SERIAL NUMBER

SUB MODULE TYPE NO SERIAL NUMBER

FAILED ITEM DESCRIPTION Capacitor, Ceramic

COLLINS PART NO 913-5019-200 CIRCUIT SYMBOL NO C41

MANUFACTURER Kemet MFGR P/N MFGR S/N

FAILURE ANALYSIS

ANALYSIS PROCEDURES AND RESULTS:

ETM at Failure: 3.4

Fail Mode: No audio out in Rcv.

Fail Mechanism: Capacitor opened. Cap. is a coupling cap. Open condition caused loss of audio.

Capacitor destroyed when removed. No further analysis.

(ATTACH ADDITIONAL SHEETS AS NECESSARY)

RELIABILITY CONTROL

CORRECTIVE ACTION REQUIRED & SERIAL NUMBER EFFECTIVITY *(IF CORRECTIVE ACTION HAS BEEN TAKEN BASED ON PREVIOUS FAILURE ANALYSIS STATE APPLICABLE FAILURE REPORT NUMBERS)*

(ATTACH ADDITIONAL SHEETS AS NECESSARY)

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FAILURE ANALYSIS REPORT
COLLINS RADIO COMPANY

FAILURE REPORT NO F9

DATE 2 Mar. 76

GENERAL DATA

UNIT TYPE NO GRC-171 UNIT PART NUMBER 622-1626-001

UNIT SERIAL NO 142 UNIT CONTRACTOR

FAILURE LOCATION DKTBF FAILURE DATE Nov. 19, 75

AS APPLICABLE

MODULE TYPE NO Chassis (A10) SERIAL NUMBER

CIRCUIT BOARD TYPE NO SERIAL NUMBER

SUB MODULE TYPE NO Front Panel (A1) SERIAL NUMBER

FAILED ITEM DESCRIPTION Switch, PTT/Carrier Switch

COLLINS PART NO 266-3072-000 CIRCUIT SYMBOL NO A10A1J4

MANUFACTURER MFGR P/N MFGR S/N

FAILURE ANALYSIS

ANALYSIS PROCEDURES AND RESULTS:

ETM at Failure: 1046.3

Failure Mode: No carrier test when switch placed on carrier test.

Failure Mechanism: Switch intermittent. Movable contact was binding against the case. Movable contact arm was off center of pivot point. This misalignment caused the intermittent condition.

(ATTACH ADDITIONAL SHEETS AS NECESSARY)

CORRECTIVE ACTION

CORRECTIVE ACTION REQUIRED & SERIAL NUMBER EFFECTIVITY (IF CORRECTIVE ACTION HAS BEEN TAKEN BASED ON PREVIOUS FAILURE ANALYSIS STATE APPLICABLE FAILURE REPORT NUMBERS)

FAILURE ANALYSIS REPORT
COLLINS RADIO COMPANY

FAILURE REPORT NO F32

DATE 2 Mar. 76

GENERAL DATA

UNIT TYPE NO AN/GRC-171 UNIT PART NUMBER 622-1628-001

UNIT SERIAL NO 184 UNIT CONTRACTOR

FAILURE LOCATION DMTBF FAILURE DATE Feb. 5, 76

AS APPLICABLE

MODULE TYPE NO. DC/DC Conv (A5) SERIAL NUMBER MCN 322

CIRCUIT BOARD TYPE NO. SERIAL NUMBER

SUB MODULE TYPE NO. 50 Watt Conv (A2) SERIAL NUMBER

FAILED ITEM DESCRIPTION Transformer

COLLINS PART NO. 674-0192-010 CIRCUIT SYMBOL NO. A5A2T1

MANUFACTURER ADC MFGR. P/N TF5SX05ZZ MFGR. S/N 7517

FAILURE ANALY...

ANALYSIS PROCEDURES AND RESULTS:

ETM at Failure: 2896.2

Failure Mode: No +5 or -12 VDC

Failure Mechanism: Interwinding short of pins 8, 9, 4, 5, and 11

Secondary Failures: Q1, Q2, F1 and R6 on A2 board

(ATTACH ADDITIONAL SHEETS AS NECESSARY)

R... RRENCE CONTROL

CORRECTIVE ACTION REQUIRED & SERIAL NUMBER EFFECTIVITY: *(IF CORRECTIVE ACTION HAS BEEN TAKEN, BASED ON PREVIOUS FAILURE ANALYSIS, STATE APPLICABLE FAILURE REPORT NUMBERS)*

(ATTACH ADDITIONAL SHEETS AS NECESSARY)

PREPARED BY _____ APPROVED BY _____

FAILURE ANALYSIS REPORT
COLLINS RADIO COMPANY

FAILURE REPORT NO See below.

DATE 2 Mar. 76

GENERAL DATA

UNIT TYPE NO C7999 UNIT PART NUMBER 622-1629-001

UNIT SERIAL NO _____ UNIT CONTRACTOR _____

FAILURE LOCATION DMTBF FAILURE DATE Various

AS APPLICABLE

MODULE TYPE NO _____ SERIAL NUMBER Various

CIRCUIT BOARD TYPE NO _____ SERIAL NUMBER _____

SUB MODULE TYPE NO _____ SERIAL NUMBER _____

FAILED ITEM DESCRIPTION Lamp - Ready

COLLINS PART NO 262-2204-090 CIRCUIT SYMBOL NO DS1

MANUFACTURER Chicago Min./Oak Ind. MFGR P/N 6839 MFGR S/N _____

FAILURE ANALYSIS

ANALYSIS PROCEDURES AND RESULTS:

Failure Mode: No ready lite

Failure Mechanism: DC notching noted on samples.

DC notching was evident. Notching inherent in all lamps where DC used. Notching causes weakening of filament and increases susceptibility to shock/vibration.

(ATTACH ADDITIONAL SHEETS AS NECESSARY)

RECURRENCE CONTROL

CORRECTIVE ACTION REQUIRED & SERIAL NUMBER EFFECTIVITY: (IF CORRECTIVE ACTION HAS BEEN TAKEN BASED ON PREVIOUS FAILURE ANALYSIS STATE APPLICABLE FAILURE REPORT NUMBERS)

Failure Report No.'s: F26, 27, 28, 29, 34, 35, 36, 39, 40, 41, 42, 43, 44

28.

(ATTACH ADDITIONAL SHEETS AS NECESSARY)

PREPARED BY _____ APPROVED BY _____

FAILURE ANALYSIS REPORT

COLLINS RADIO COMPANY

FAILURE REPORT NO See Below

DATE 2 Mar. 7[illegible]

GENERAL DATA

UNIT TYPE NO C7999 UNIT PART NUMBER 622-1628-[illegible]

UNIT SERIAL NO Various UNIT CONTRACTOR

FAILURE LOCATION DMTBF FAILURE DATE Various

AS APPLICABLE

MODULE TYPE NO SERIAL NUMBER

CIRCUIT BOARD TYPE NO SERIAL NUMBER

SUB MODULE TYPE NO SERIAL NUMBER

FAILED ITEM DESCRIPTION Edge lit panel lites

COLLINS PART NO 754-0040-001 CIRCUIT SYMBOL NO

MANUFACTURER MFGR. P/N MFGR S/N

FAILURE ANALY.

ANALYSIS PROCEDURES AND RESULTS:

Failure Mode: No panel lighting

Failure Mechanism: Failures result of DC notching.

(ATTACH ADDITIONAL SHEETS AS NECESSARY)

RE. SRENCE CONTROL

CORRECTIVE ACTION REQUIRED & SERIAL NUMBER EFFECTIVITY: *(IF CORRECTIVE ACTION HAS BEEN TAKEN, BASED ON PREVIOUS FAILURE ANALYSIS STATE APPLICABLE FAILURE REPORT NUMBERS)*

Failure Reports: F20, 21, 22, 30, 31, 38

(ATTACH ADDITIONAL SHEETS AS NECESSARY)

PREPARED BY APPROVED BY

FAILURE ANALYSIS REPORT
COLLINS RADIO COMPANY

FAILURE REPORT NO [illegible]

DATE 2 Mar. 7[illegible]

GENERAL DATA

UNIT TYPE NO C7990 UNIT PART NUMBER 622-1629-001

UNIT SERIAL NO Various UNIT CONTRACTOR

FAILURE LOCATION DMTBF FAILURE DATE Dec. 28, 31; Jan. 2, [illegible]

AS APPLICABLE

MODULE TYPE NO SERIAL NUMBER

CIRCUIT BOARD TYPE NO SERIAL NUMBER

SUB MODULE TYPE NO SERIAL NUMBER

FAILED ITEM DESCRIPTION Lamp - Ready

COLLINS PART NO 262-2204-090 CIRCUIT SYMBOL NO DS1

MANUFACTURER Chicago Min./Oak Ind. MFGR P/N 6839 MFGR S/N

FAILURE ANALY[illegible]

ANALYSIS PROCEDURES AND RESULTS

Failure Mode: No ready lite

Failure Mechanism: DC notching noted on all samples.

A test equipment power supply problem occurred during this time span. Although the power supply that failed was not the supply that provides lamp power, potential of ground path effects exist. A change of applied potential to the lamps would accelerate the rate of DC notching.

No failure of lamps occurred for a period of two weeks after this group of failures. Subsequent failures of lamps have been at a rate of 1 to 2 per week.

(ATTACH ADDITIONAL SHEETS AS NECESSARY)

[illegible]RRENCE CONTROL

CORRECTIVE ACTION REQUIRED & SERIAL NUMBER EFFECTIVITY: (IF CORRECTIVE ACTION HAS BEEN TAKEN BASED ON PREVIOUS FAILURE ANALYSIS STATE APPLICABLE FAILURE REPORT NUMBERS)

Failure Report No.'s: F14, F15, F16, F17, F18, F[illegible]

[illegible]

[illegible]

FAILURE ANALYSIS REPORT
COLLINS RADIO COMPANY

FAILURE REPORT NO See below

DATE 2 Mar. 76

GENERAL DATA

UNIT TYPE NO AN/GRC-171 UNIT PART NUMBER 622-1628-001

UNIT SERIAL NO Various UNIT CONTRACTOR

FAILURE LOCATION DMTBF FAILURE DATE

AS APPLICABLE

MODULE TYPE NO Chassis (A10) SERIAL NUMBER

CIRCUIT BOARD TYPE NO SERIAL NUMBER

SUB MODULE TYPE NO Front Panel (A1) SERIAL NUMBER

FAILED ITEM DESCRIPTION Lamp - Pwr ON/OFF (Non-Relevant Failures)

COLLINS PART NO 262-1856-000 CIRCUIT SYMBOL NO A10A1DS1

MANUFACTURER MFGR. P/N MFGR S/N

FAILURE ANALY

ANALYSIS PROCEDURES AND RESULTS:

Failure Mode: Power ON/OFF lamp out either during or shortly after a bench check

Failure Mechanism: Analysis indicates presence of DC notching. Notching is aggravated by shock/vibration/test method during bench checks of RT.

Comment: Failures of power lamp are non-relevant

(ATTACH ADDITIONAL SHEETS AS NECESSARY)

BREAK CONTROL

CORRECTIVE ACTION REQUIRED & SERIAL NUMBER EFFECTIVITY: *(IF CORRECTIVE ACTION HAS BEEN TAKEN BASED ON PREVIOUS FAILURE ANALYSIS STATE APPLICABLE FAILURE REPORT NUMBERS)*

Failure Report No.'s: F10, F11, F12, F13, F24, F25, F37

41.

(ATTACH ADDITIONAL SHEETS AS NECESSARY)

APPROVED BY

FAILURE ANALYSIS REPORT
COLLINS RADIO COMPANY

FAILURE REPORT NO F-46

DATE 7 June 76

GENERAL DATA

UNIT TYPE NO AN/ARC-171 UNIT PART NUMBER 622-1628-001

UNIT SERIAL NO 54 UNIT CONTRACTOR

FAILURE LOCATION ONTBF FAILURE DATE Mar 4, 76

AS APPLICABLE

MODULE TYPE NO Power Amp (A8) SERIAL NUMBER MCN 337

CIRCUIT BOARD TYPE NO SERIAL NUMBER

SUB MODULE TYPE NO SERIAL NUMBER

FAILED ITEM DESCRIPTION Reflectometer

COLLINS PART NO 623-5865-001 CIRCUIT SYMBOL NO A7

MANUFACTURER Collins MFGR P/N MFGR S/N

FAILURE ANALYSIS

ANALYSIS PROCEDURES AND RESULTS

ETM at failure: 3854.1 hours

Failure mode: Front panel meter % modulation erratic

Failure mechanism: Problem traced to reflectometer in PA module. Forward power output signal erratic at operating temperature. Circuit consists of a diode and two capacitors. Appears electrically OK at 25°C.

(ATTACH ADDITIONAL SHEETS AS NECESSARY)

REFERENCE CONTROL

CORRECTIVE ACTION REQUIRED & SERIAL NUMBER EFFECTIVITY: *(IF CORRECTIVE ACTION HAS BEEN TAKEN, BASED ON PREVIOUS FAILURE ANALYSIS STATE APPLICABLE FAILURE REPORT NUMBERS)*

42.

(ATTACH ADDITIONAL SHEETS AS NECESSARY)

4.5 Radio Set Control (C-7999)

4.5.1 Testing: As a condition of the DMTBF test plan the radio set controls were tested in a simulated operational environment. Appropriate voltages were applied to the panel lights, ready lights and frequency control diodes during testing. In addition, the control heads were used during daily bench checks.

4.5.2 Failures: After 2000 test hours on the first sample lot numerous panel and ready light failures began to occur. As the second and third test lot samples approach this operating time they also exhibited similar failures. An investigation was conducted by Collins Radio and it was determined that panel and ready lights used in the control head did not meet the reliability requirements of the specification. In response to this problem Collins Radio submitted ECP #9. This ECP was approved and all panel and ready lights listed as non-relevant failures. Testing on the original control configuration ended on 12 Apr 76. To that date some 27 ready lights and 9 panels had failed. The units were modified and testing resumed on 29 Apr 76. Testing will continue for 5,000 calendar hours and will end on 23 Nov 76. At this time a new DMTBF will be calculated and an additional report disseminated.

ENGINEERING CHANGE PROPOSAL, PAGE 1
(SEE MIL STD 480 FOR INSTRUCTIONS)

DATE PREPARED: 24 March 1976

PROCURING ACTIVITY NO.:

1. ORIGINATOR NAME AND ADDRESS: COLLINS RADIO GROUP, ROCKWELL INTERNATIONAL, CEDAR RAPIDS, IOWA

2. CLASS OF ECP	3. JUST. CODE	4. PRIORITY
1	D	U

5. ECP DESIGNATION

a. MODEL/TYPE	b. MFR. CODE	c. SYS. DESIG.	d. ECP NO.	e. TYPE	f. REV.	g. CORR.
C-7999	13499	AN/GRC-171	9	F	R1	

6. BASELINE AFFECTED: ☐ FUNCTIONAL ☐ ALLOCATED ☒ PRODUCT

7. OTHER SYS./CONFIG. ITEMS AFFECTED: ☐ YES ☒ NO

8. SPECIFICATIONS AFFECTED – TEST PLAN

	MFR CODE	SPEC./DOC. NO.	SCN
a. SYSTEM	none		
b. ITEM	none		
c. TEST PLAN	none	MMEE 1-75	

9. DRAWINGS AFFECTED

MFR CODE	NUMBER	REV.	NOR NO.
13499	622-1629-001		
13499	623-6404-001		

10. TITLE OF CHANGE: IMPROVE LAMP LIFE

11. CONTRACT NO. & LINE ITEM: F34601-73-C-0691

12. CONFIGURATION ITEM NOMENCLATURE: C-7999/GRC-171

13. IN PRODUCTION: ☒ YES ☐ NO

14. NAME OF PART OR LOWEST ASSEMBLY AFFECTED: REMOTE CONTROL UNIT

15. PART NO. OR TYPE DESIGNATION: 622-1629-001

16. DESCRIPTION OF CHANGE

A. Equipment Change-Change Lamp DS1 from 262-2204-090 to 262-0934-000. Add Resistor Assy 635 8207-001 containing resistors R3, 747-5390-000(390 ohms, 3 watts) and R4, 747-5375-000 (27 ohms, 3 watts). See Attachment C for detailed Resistor Assembly hook-up. Change Light Panel 754-0040-001 to 754-0040-003 to an assembly containing improved lamps.

B. Collins Radio proposes no change in part number for the end item C-7999 Control to preclude the necessity of nomenclature and nameplate changes to delivered units.

C. Test Plan Change--The Test Plan will be changed as described in Attachment A.

17. NEED FOR CHANGE

A. Equipment Change--The ready lamp DS1 and the panel lamps exhibit a wear-out life which is less than that required by the specification. The changes in this proposal will delay the wear-out and thus extend the life of the lamps to meet the specification requirements.

B. Test Plan Change--The Test Plan must be changed to agree with Attachment .

18. PRODUCTION EFFECTIVITY BY SERIAL NUMBER: 1st Unit of Production Option 1

19. EFFECT ON PRODUCTION DELIVERY SCHEDULE: none

20. RETROFIT

a. RECOMMENDED ITEM EFFECTIVITY: C-7999 S/N 10 thru 1277 and 1576 thru 1583

c. SHIP/VEHICLE CLASS AFFECTED: UNKNOWN

b. ESTIMATED KIT DELIVERY SCHEDULE: SEE ATTCH. B, PROPOSED RETROFIT SCHEDULE

d. LOCATIONS OR SHIP/VEHICLE NUMBERS AFFECTED: UNKNOWN

21. ESTIMATED COSTS/SAVINGS UNDER CONTRACT: SEE LETTER OF TRANSMITTAL

22. ESTIMATED NET TOTAL COSTS: SEE LETTER OF TRANSMITTAL

23. SUBMITTING ACTIVITY AUTHORIZING SIGNATURE: ROGER W. ZERAN

TITLE: PROGRAM MANAGER

24. APPROVAL/DISAPPROVAL

a. CLASS I: ☐ APPROVAL RECOMMENDED

b. CLASS II: ☐ APPROVED ☐ DISAPPROVED ☐ CONCUR IN CLASSIFICATION OF CHANGE ☐ DO NOT CONCUR IN CLASSIFICATION OF CHANGE

c. GOVERNMENT ACTIVITY	SIGNATURE	DATE

DD [illegible] 1692

ATTACHMENT A

ATTACHMENT A

Plan for Revision of Remote Control Unit Ready and Panel Lamp in the GRC-171 System.

Collins Radio Group proposes to manufacture the quantities of C-7999 Remote Control Units remaining on the contract in accordance with ECP #9 of which this plan is a part. It further proposes to modify all Remote Control Units previously delivered in accordance with the procedures.

VERIFICATION TESTING

The following testing procedure is proposed for the remainder of the DMTBF testing. The Remote Control Units on test shall be modified as outlined above. The Remote Control Units shall then be returned to the test. The modified controls will remain on test until the transceiver unit completes the test. Only failures occurring after the modification shall be included in the DMTBF determination. Based on a 31 March approval of this ECP, the modification and return to test of the Remote Control Units will be completed no later than 9 April. This will allow approximately 1500 hours of test time before the completion of the test.

It it is desirable to extend the test period to increase confidence in the ECP action the demonstration test may be modified as follows: At the completion of the present demonstration testing the modified Remote Control Units will remain on test until they have accumulated 3000 hours of test time per unit. Any failure of the Remote Control Unit other than lamps shall be classified as relevant only up to the end of the normal test period. After this period only failures of the ready and panel lamps and circuitry added by the modification shall be considered chargeable failures. This extended test will be completed approximately 2 months after completion at the normal test.

ATTACHMENT B

ATTACHMENT B

PROPOSED RETROFIT SCHEDULE

	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN
ECP #9 APPROVAL	31										
AFLC 874 SUBMITTED		15									
AFLC 874 APPROVED BY SACTO			15								
TCTO DRAFT TO SACTO			31								
TCTO DRAFT APPROVAL				15							
TCTO NEGATIVES TO SACTO				22							
TCTO COPIES FOR KITS					31						
TCTO KITS AVAILABLE						31					
FIELD RETROFIT STARTS							1				
FIELD RETROFIT COMPLETE											31

ATTACHMENT C

C-7999/GRC-171 PANEL LAMP AND READY LAMP MODIFICATION

1. Remove dust cover from control
2. Loosen set screw and remove volume control knob.
3. Remove two screws from the lighted front panel, remove panel and discard.
4. Remove the two screws securing the printed circuit board to the rear panel stand-off posts.
5. Mount resistor assembly 635-8207-001 using screws removed in Step. 4.
6. Remove the solid green wire from J1 pin 23 and connect to terminal E-1 on resistor assembly mounted in Step 5.
7. Connect the wire from terminal E-2 on resistor assembly to J-1 pin 23.
8. Reassemble the printed circuit board and rear panel assembly to the unit.
9. Remove the green lens and ready lamp bulb.
10. Remove the white wire from J2 to the ground lug at the front panel.
11. Connect the wire from terminal E-3 on the resistor assembly to J-2. Connect the white wire from terminal E-4 to the ground lug at the front panel.
12. Replace the ready bulb with type 685 bulb, CPN 262-0934-000, and replace lens.
13. Install the lighted front panel 754-0040-003 on the control.
14. Replace volume control knob.
15. Replace dust cover on unit.

4.6 Power On Lights

4.6.1 Failures: On 1 Dec 1975 the first power on light failure occurred. The radios were normally shut on and off several times during the course of a daily bench check to remove and/or attach interface cables. It was at this time that power on light (DS-1) would fail. A total of eleven power on lights failed in the course of DMTBF testing.

4.6.2 Relevancy: As required by the Test Plan (Para 9.1) Collins Radio submitted a request that all power on lights be considered non-relevant failures. Their contention was that no operational impact on radio performance occurred as a result of these failures. The Procuring Contract Offices, after an evaluation by the test team, concurred with the contractor's analysis. Collins Radio however, agreed to investigate changes to the power on light circuitry to improve performance. Copies of Collins' original submittal and the test team's analysis are included for reference. No corrective action had been initiated to eliminate this problem prior to the date of this report.

30 JAN 1976

PPZCB

Contract F34601-73-0691, Pilot Light Failures on DITIF Test

Collins Radio Group
5225 C Avenue NE
Cedar Rapids IA 52406

1. Reference your letter DVR1275-21 dated 19 Dec 75. We concur that the power pilot lamp failures should be classified as non-relevant.

2. This interpretation does not include the "ready" lamps on the R/T unit and the remote control head. These lamps are required to determine proper operation of the equipment by the operators whereas the power pilot lamp does not directly affect operation.

Original Signed By

RAUL E. RODRIGUEZ
Contracting Officer

PPZCB OFFICIAL FILE COPY

DEPARTMENT OF THE AIR FORCE

HEADQUARTERS SACRAMENTO AIR LOGISTICS CENTER AFLC

MCCLELLAN AIR FORCE BASE, CALIFORNIA 95652

MMEE 7 JAN 1976

Contract F34601-73-C-0691, Collins Letter DVR1275-21, Pilot Lamp Failures on AN/GRC-171 DMTBF Test

09 JAN 1976 ZC/Rodriguez

1. Subject Collins letter requests that AN/GRC-171 power pilot lamp failures during the DMTBF test be classified as non-relevant failures, thus excluding them from the DMTBF cost calculations.

2. This request is granted for the power pilot lamp only. This interpretation does not include the "ready" lamps on the R/T unit and the remote control head or the edge lighting lamps on the remote control. These lamps are required to determine proper operation of the equipment by the operators whereas the power pilot lamp is a convenience feature which does not directly affect operation.

Robert P. Green

ROBERT P. GREEN
Chief, Electronics Branch
Directorate of Materiel Management

Cy to: MMCTA
MMCOA
MMEWC

Collins Radio Group
Cedar Rapids, Iowa 52406
(319) 395-1000
Cable COLINRAD Cedar Rapids

Rockwell International

19 December 1975

In Reply Refer to: DVR1275-21

Department of the Air Force
Sacramento Air Logistics Center
McClellan Air Force Base, California 95652

DEC 1975

Attention: PPZCB/Raul Rodriguez

Subject:q Contract F34601-73-C-0691,
AN/GRC-171 Equipment,
Pilot Lamp Failures on AN/GRC-171 DMTBF Test

Gentlemen:

The following discussion is offered, in accordance with Paragraph 9.1 of Test Plan MMEE 1-75, as evidence that the subject failures should be considered as non-relevant.

During the week of 30 November there were three (3) failure of DS-1, the primary power pilot lamp. During the week of 15 December, another failure of this lamp occurred. These failures occurred during or within a few hours of the daily bench checks performed as part of the DMTBF Test. We have been informed, through discussions with the Air Force personnel, that these failures are considered to be relevant failures under the terms of the Test Plan MMEE 1-75. This means they will be counted on the calculations of the penalty of incentive payment under clause J-1 of the Contract. It is our contention that these failures are non-relevant and the following explanation is offered to support our position.

Paragraph 9.1 of Test Plan MMEE 1-75 defines a failure as any malfunction which requires adjustment, repair, replacement, or maintenance to restore the equipment to operational status. Operational status is defined as operation in accordance with the requirements of OCNEE 66-69A, its amendments, and clarifications thereto. The power pilot lamp, DS-1, is not required in order for the equipment to perform in accordance with these requirements. Two scenarios describing the intended operation of the equipment will illustrate this point. In the first example, the equipment is installed in an equipment room and operated from a remote position out of view of the operator. Indication of power "on" and proper operation is provided to the remote operator through the "ready" lamp, through the position of the power on-off switch, and by the lighting of the front panel of the remote control. Thus,this information, which is the only function of the pilot lamp, is provided through these other means. In the second example, the equipment is operated under local control. In this case the operator can see the pilot lamp and would use it as an indication of the power status of the equipment. If the equipment was turned on and operating correctly, the "ready" lamp will be lighted. This will indicate to the operator that the equipment is energized and receiving the power required to operate it regardless of the status of the pilot lamp. Additionally the test meter on the front panel provides indication of the proper operation of the equipment. Given these indications the operator would continue to operate the equipment. If the "ready" lamp were not lighted or the meter indicates that the power was not available, some maintenance action would be required, again in spite of, rather than because of the pilot lamp. The equipment meets the operational requirements of OCNEE 66-69A with or without the power pilot lamp.

There is one case where the pilot lamp is of value and that is during maintenance. If a unit has failed and maintenance is required, it provides the maintenance man with an easy indication of the power status of the equipment. In the Technical Order for the GRC-171 under the section labeled "Performance Tests" the first step for determining proper operation is to turn the equipment on and observe the "power" and "ready" lamps. If in the course of a maintenance action for some reported fault, the power lamp was determined to be burned out, it would be replaced before proceeding to further testing. While the lamps then would be part of the maintenance it could be considered as a secondary failure and not the cause of the maintenance action.

There is another point worthy of consideration in the determination of the relevancy of these failures. During the design of the GRC-171 some considerable thought was given to the selection of the proper bulb for use in the GRC-171 lamps. Paragraph 6.2 of OCNEE 66-69A states that the intent of the specification is to produce a reliable transceiver which "may be expected to operate continously in excess of six months in a typical air traffic control environment without failure of parts or degradation of performance." Since the "typical air traffic control environment" involves long periods of operation with the equipment energized, lamps which give long life in this service were selected. Lamp life is dependent on its construction which must be matched to its intended use. If the lamp is to be turned on and off frequently, the filament should be heavy and rugged to withstand the stresses caused by the frequent heating and cooling, since the primary failure mode is mechanical breakage. This also means lamp current will be high and more heat will thus be generated. In the application defined by OCNEE 66-69A the equipment is on a large percentage of the time with only infrequent off and on cycling of the power. For maximum life under this service, a lamp should be operated at some voltage, preferably at least ten percent, less than the rated voltage since the primary failure mode is evaporation of the filament by the heat it generates. This means a less rugged filament from a mechanical standpoint but the lower heat output extends the life greatly. The bulb used in the GRC-171 is a type 1828 rated at 37.5 volts. When operated at 26 volts as it is on the GRC-171, its life is rated in excess of 30,000 hours continuous operation.

During DMTBF testing at Sacramento daily bench checks require turning the equipment off and on several times in a short span of time. The subject failures occurred during or very shortly after the unit was turned on and off in the course of these bench checks. It is our contention that these bench checks, while serving a purpose in proving the reliability of the equipment, subject the equipment to conditions which could not be encountered in a "typical air traffic control environment". These lamp failure therefore, should be considered as test-related rather than design-related and not charged against the design of GRC-171.. To do otherwise is to penalize our efforts to provide equipment to meet the intent of the specification.

Your early review and response to the above is respectfully requested.

Very truly yours,

J. Reed

J. Reed
Contract Manager
Communication Equipment & Systems

4.7 Bench Tests: Two radio repairers were tasked to perform daily bench checks on the test radios to monitor performance. The procedures they used are included in the Test Plan and are similar to tests outlined in T.O. 31R2-2GRC171-6WC-1. These tests provided additional failure detection. Test data is on file at SM-ALC but is not included in this report since no significant trends were discovered.

4.8 Computer Testing: Prior to delivery all AN/GRC-171 Transceivers are submitted to a comprehensive test by ATE at the manufacturers plant. This data has been provided on the DMTBF test radios. At the completion of testing the thirty test radios were shipped to Collins to repeat this testing. This new data will be used for comparison with the original test data to provide information on operational performance and degradation. Any additional failures found during this testing will be used to recalculate the DMTBF for payment purposes.

FINAL ACCEPTANCE INSP.

TM-7949 REV. 9 DATA PAGE 1 OF 10

TESTED BY 18301

PRODUCTION TEST DATA
FOR
RT-980/GRC-171
CPN 622-1628-001

SER. NO. 205
MCN NO. 442
DAY240
TIME 7 44

NOTICE: THIS DOCUMENT IS CONTROLLED BY THE ACCEPTANCE TEST PROCEDURE, CPN 623-5999-001, NO CHANGES TO THE COMPUTER PROGRAM ARE AUTHORIZED WHICH AFFECT A.T.P. DATA ITEMS WITHOUT GOVERNMENT APPROVAL. A.T.E. PROGRAM CPN 629-2098-005

REFERENCE PARAGRAPH

DEPT 15 SECTION 759
UUT CPN 622-1628-001
PROC REV 9
FISCAL WK 5-4-83
QUALITY CONTROL STAMP

(*)5.1.2 POWER SUPPLY OUTPUT, 120V OPERATION

	LIMITS
DC VOLTAGE AT RECT DC TEST POINT = 50.584	25-55 V
DC VOLTAGE AT J22-C = 50.637 (BATTERY CHARGER)	25-55 V

RIPPLE VOLTAGE AT RECT DC TEST POINT = .2686	LIMITS 1 VRMS

(*)5.2.1 POWER CONSUMPTION, TRANSMIT (120V,60HZ)

	LIMITS
306.722 WATTS	NMT 550W

WARM-UP TIME
FREQUENCY
225000 KHZ & 50 HZ ; LIMIT 225MHZ +- 1KHZ

(*)5.2.2 POWER OUTPUT (50 OHMS) AND FREQUENCY

FREQUENCY SETTING	ACTUAL KHZ + HZ	POWER OUTPUT	LIMITS
225	225000 60		+- 1KHZ
225		23.3	18-24.4W
250		23	18-24.4W
275		22.9	18-24.4W
300	300000 90		+- 1.2KHZ
300		22	18-24.4W
325		23.2	18-24.4W
350		22.6	18-24.4W
377.775		23.5	18-24.4W
399.9	399900 130		+- 1.6KHZ
399.9		23.4	18-24.4W

FREQUENCY RESETABILITY

FREQUENCY SETTING	ACTUAL KHZ + HZ	LIMITS
225	225000 70	+- .9KHZ
300	300000 100	+- 1.2KHZ
399.9	399900 120	+- 1.6KHZ

TM-7949 REV. 9 DATA PAGE 2 TESTED BY 18301
MCN NO. 442
DAY 248
TIME 7 44

(*)5.2.5 MODULATION PERCENTAGE (300.0 MHZ)

(V = 2.45 V, 1000 HZ)	LIMITS
% NEGATIVE = 93.1	85-95%

MODULATION PERCENTAGE (V = 0.135V)	LIMITS
% NEGATIVE = 92.6	75-95%

OVERMODULATION (7.75 V AUDIO INPUT)	LIMITS
% NEGATIVE = 93	< 100%

(*)5.2.6 MODULATION DISTORTION (90% NEGATIVE MODULATION)

(V = .135V, 1000 HZ, 300.0 MHZ)	LIMITS
4.3 % DISTORTION	10%

(*)5.2.7 XMIT MAIN AUDIO FREQUENCY RESPONSE(.135V, 300.0 MHZ)

FREQUENCY	DET A.F. LEVEL	LIMITS
1000	0 DB	REFERENCE
100	-12.6 DB	< -10DB
300	0 DB	+1,-2DB
6000	-.9 DB	+1,-2DB
10000	-13.2 DB	< -10DB

(*)5.2.8 XMIT DATA AUDIO INPUT(0.775 V, 1 KHZ, 300.0 MHZ)

	LIMITS
% NEGATIVE = 92.3	85-95%

(*)5.2.10.1 REMOTE READY LAMP ON?(300.0 MHZ) YES

REMOTE POWER SWITCH OPERATIONAL? YES

TESTED BY 18301
MCN NO. 442
DAY 240
TIME 7 44

(*)5.2.10.2 TRANSMITTER KEYING (OUTPUT POWER OBSERVED, 300.0 MHZ)

CENTER TAP OF MAIN AUDIO?	YES
REAR CARBON MIC PTT?	YES

(*)5.2.10.3 KEYING MODULE (300.0 MHZ)

VOLTAGE KEYING?	YES
CURRENT KEYING?	YES
TONE KEYING?	YES

(*)5.2.10.4 REMOTE FREQUENCY SELECTION

ALL DIGITS OPERABLE?	YES

(*)5.2.10.5 REMOTE SQUELCH RELAY (300.1 MHZ)

SQUELCH ON	LIMITS
COM TO N.C.= .173	NMT 1 OHM
COM TO N.O.= 1.30607E+07	> 100KOHM
SQUELCH OFF	
COM TO N.O.= .162	NMT 1 OHM

(*)5.2.11 MIC INPUTS (300.0 MHZ., 1 KHZ. MOD. FREQ.)

REAR CARBON	LIMITS
% NEGATIVE = 92.1	85-95%
FRONT CARBON	LIMITS
% NEGATIVE = 92.3	85-95%
FRONT DYNAMIC	LIMITS
% NEGATIVE = 92.3	85-95%

5.2.12 SIDETONE (300.0 MHZ)

			LIMITS
(*)5.2.12.1	8.8	VRMS OUTPUT	6.75-9.5V
5.2.12.2	4.1	% DISTORTION	NMT 10%

TM-7949 REV. 9 DATA PAGE 4 TESTED BY 18301
MCN NO. 442
DAY 240
TIME 7 44

(*)5.3.1 POWER CONSUMPTION, RECEIVE (120V, 60 HZ, 225.1 MHZ)

	LIMITS
127.133 WATTS	NMT 150W

(*)5.3.2 MAIN RECEIVER SENSITIVITY & AUDIO OUTPUT
(6 UV OPEN CIRCUIT, 30% AM, 1000 HZ)

R.F. INPUT FREQUENCY	AUDIO OUT NLT 100MW	S+N/N RATIO NLT 10DB
225.1	160	14.5
250.1	152.2	14.3
275.1	154.2	15.7
300.1	148.7	13.9
325.1	148.3	14.1
350.1	143.9	14.4
375.1	152.8	15.6
399.975	165.1	16.7

FREQUENCY RESETABILITY

FREQ.	S+N/N RATIO	LIMITS
225.1	15.6	NLT 10DB
300.1	13.8	NLT 10DB
399.975	16.7	NLT 10DB

(*)5.3.4 RECEIVE MAIN AUDIO RESPONSE (300.1 MHZ, 100 UV, 30% MOD)

MODULATION FREQUENCY	AUDIO OUTPUT		LIMITS
1000	0	DB	REFERENCE
100	-15.2	DB	NLT 10DB
300	-.7	DB	+1,-2DB
3000	-.4	DB	+1,-2DB
10000	-29.4	DB	NLT 10DB

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(*)5.3.7 HEADSET OUTPUT (5 UV, 30% MOD, 1 KHZ, 300.1 MHZ)

100 MW OBTAINED? YES

(*)5.3.8 RECEIVE DATA AUDIO RESPONSE (1000UV,30%MOD,300.1MHZ,DIST)
(100UV,30%MOD,300.1MHZ,RESP)

MODULATION FREQUENCY	AUDIO OUTPUT	DIST.	LIMITS
1000	.80388	3.4	>.5V, <10%
25	-.4		+- 10B
10	-1		+1,-30B
8000	-.2		+- 10B
*25 KHZ	NA		
1 KHZ @ 6 UV	.8162		NLT .5V

(*)5.3.11 IF BANDWIDTH (300.1 MHZ, 12 UV, NO MODULATION)

		LIMITS
FREQ ERROR = 50 -0.531 (@ 270.1 MHZ)		REFERENCE
(1) AGC REF = ~~-.5405~~ -0.814	VDC	REFERENCE
(2) 6 DB UPPER ~~-.8709~~ -2.830	VDC.	NL NEG. THAN REF.
LOWER ~~-.8017~~ -0.465	VDC	NL NEG. THAN REF.
(3) 80 DB UPPER ~~-.3298~~	VDC	NM NEG. THAN REF.
LOWER ~~-.0139~~ -0.501	VDC	NM NEG. THAN REF. ~~APPEL~~ Khl

OK Manual 8-28-75 Khl

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5.4.1 MIC CURRENT (300.0 MHZ)

VOLTAGE DEVELOPED ACROSS 100 OHM RESISTOR		LIMITS
-4.1643	VOLTS	-3.5,-4.5V

5.4.3 TEST POINTS	VOLTAGE	LIMITS
(300.0 MHZ, NO MODULATION, IN XMIT)		
PA FWD	.6916	0.5-1.2V
PA REF	.0192	-.2,+.3V
ALC	1.118	0.5-2.5V
KEY	.0848	0.05-0.5V
(300.0 MHZ, 90% MODULATION)		
XMIT AUDIO	.9299	.6-1.1V
(312.5 MHZ, 30%, 1000 HZ, 6 UV, IN RCVR)		
SERVO +	4.3043	-0.2-6.5V
SERVO -	.0416	-0.2-6.5V
TUNE VOLT	.0099	+- 0.1V
PLL OUT	.775	0.2-1.5V
PLL FAULT	4.4003	2-5V
IF AGC	-.473	-.3,-.7V
RCV AUDIO	.2443	.16-.3V

5.4.4 DC POWER OPERATION(300.0 MHZ IN XMIT, 300.1 MHZ IN RCV)

	LIMITS
+26V BAT CHG = 25.918	25.5-26.5V
RF POWER OUT = 21.8	18-24.4W
300.0 MHZ FREQ = 300000 50	+- 1.2KHZ
SENSITIVITY = 14	NLT 10DB
AUDIO OUTPUT = 135.9	NLT 100MW

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(*)5.1.3 PANEL LAMPS AND METER (300.0 MHZ)

POWER LAMP LIT?✓ *MANUAL*

READY LAMP LIT?✓ *MANUAL*

* 26 V T.P. READING	LIMITS
26.008 V DC	25.5-26.5V

PANEL METER READING 26.0 VDC *-1.5ACT*MANUAL*

PANEL METER VOLTAGES

METER POSITION	PANEL METER READING	LIMITS
+ 22V	21.5 V	20.5-23.5*MANUAL*
+ 12V	12.0 V	11.0-13.1*MANUAL*
+ 5V	5.1 V	4.62-5.6 *MANUAL*
- 12V	-12.0 V	-11 -13.1*MANUAL*

(*)5.2.2 INTERNAL / EXTERNAL POWER METERS

LIMITS

300 MHZ INTERNAL FWD POWER = 21.5 WATTS *MANUAL*

DIFFERENCE BETWEEN EXT. & INT. METERS = 0.5 W +-10% *MANUAL*

FREQUENCY SELECT SWITCHES OPERATE OK?✓ *MANUAL*

FRONT PANEL KEYING (300.0 MHZ)

CARBON MIC OK?✓ *MANUAL*

DYNAMIC MIC OK?✓ *MANUAL*

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(*)5.2.3 POWER OUTPUT, 3.1 VSWR

FREQUENCY	MIN.PWR.	MAX.PWR.	LIMITS
225.000MHZ	22.0 -WATTS	24.7 -WATTS	16-32W *MANUAL*
300.000MHZ	20.7 -WATTS	23.7 -WATTS	16-32W *MANUAL*
399.900MHZ	19.4 -WATTS	25.3 -WATTS	16-32W *MANUAL*

REFLECTED POWER AT 300 MHZ (EXT.PWR.METER)

4.9 -WATTS 4 - 8W *MANUAL*

DIFFERENCE BETWEEN EXT.AND INT.METERS

0.3 -WATTS +- 10% *MANUAL*
OF EXT. METER

(*)5.2.4 VSWR SHUT DOWN

FREQUENCY	POWER OUTPUT	LIMITS
225.000MHZ	5.0 -WATTS	NMT 7W *MANUAL*
300.000MHZ	5.0 -WATTS	NMT 7W *MANUAL*
399.900MHZ	5.0 -WATTS	NMT 7W *MANUAL*

(*)5.2.5 INTERNAL MODULATION METER 90.0 % 10% REF *MANUAL*

(*)5.2.9 XMIT DATA AUDIO FREQUENCY RESPONSE (300.0 MHZ)

FREQUENCY	DET.A.F.LEVEL	LIMITS
1000	@0.4 DB	REFERENCE
10000	-1.4 DB	+1,-3DB *MANUAL*
25000	-1.4 DB	+1,-3DB *MANUAL*
300	+0.5 DB	+1,-3DB *MANUAL*
1000	@0.2 DB	REFERENCE
100	-0.5 DB	+1,-3DB *MANUAL*
16	-1.7 DB	+1,-3DB *MANUAL*

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5,3,2,1 NOISE BLANKER OPERATION --✓--- *MANUAL*

(*)5,3,3 SQUELCH PERFORMANCE (300,1 MHZ, 1000 HZ)

(2) AUDIO OUTPUT = 12.2 VRMS > 7,25V *MANUAL*
(100 UV RF OPEN CIRCUIT, 30% MOD)

(3) AUDIO INCREASE = 0.9 DB NMT 3DB *MANUAL*
(90% MOD, 100 UV)

(4) AUDIO LEVEL DROPS?--✓--- *MANUAL*

(SQUELCH GATE CLOSED @ 50 UV)

(5) LOCAL SQUELCH ON/OFF OPERATIONAL?--✓--- *MANUAL*

(5) REMOTE SQUELCH ON/OFF OPERATIONAL?--✓--- *MANUAL*

(7) AUDIO OUTPUT?--✓--- *MANUAL*
(4 UV RF, OPEN CIRCUIT)

(8) AUDIO LEVEL DROPS TO 0.01 V NMT 0.1 *MANUAL*
SQUELCH GATE CLOSED AT NMT 3UV--✓--YES(CHECK) *MANUAL*

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(*)5,3,5 RECEIVER MAIN AUDIO DISTORTION
(300,1 MHZ, 1,0 V RF INPUT TO ANTENNA)

% MODULATION	AUDIO DISTORTION	LIMITS
30%	3.5	10 % *MANUAL*
90%	9.0	15 % *MANUAL*

(*)5,3,6 AGC PERFORMANCE (300,1 MHZ, 30% MOD AT 1000 HZ)

LIMITS

(1) AUDIO OUTPUT (12 UV) 10.7 VRMS REFERENCE

(2) AUDIO CHANGE FOR 1V RF SIGNAL 2.0 NMT 3DB*MANUAL*

(*)5,3,9 IMAGE RESPONSE

LIMITS

(1) AGC VOLTAGE (12 UV, OPEN CIRCUIT, 399,975 MHZ)

-0.54 VOLTS REF, *MANUAL*

(2) AGC VOLTAGE (120,000 UV, 339,975 MHZ)

+0.39 VOLTS, NOT MORE NEGATIVE THAN STEP 1 *MANUAL*

(*)5,3,10 ANTENNA RADIATION AT 205 MHZ (TRANSCEIVER SET TO 235,0 MHZ)

LIMITS

2.0 UV < 20UV *MANUAL*

5,4,2 IF OUTPUT (300,1 MHZ, 12 UV, NO MODULATION)

LIMITS

9.2 MV 5-15MV *MANUAL*

END GRC-171 TESTING, DAY: 240 HOUR: 8 MIN: 4

4.9 Problem Areas

4.9.1 Temperature: Initially temperature requirements were a problem until radio racks were stripped for improved air circulation. The test laboratory was not properly air conditioned and normal operating temperature at the thermocouples would continually approach test limits if the floor fans were shut down. No overtemperature conditions occured on any test radios.

4.9.2 Power: AC line power was continuously monitored during testing and numerous alarms occured. Alarms were primarily due to undervoltage caused by momentary power losses. On one occassion early in testing, AC power to the test area was shut down accidently. All radios were bench checked and no failures occured. Some damage to the ATE resulted however.

4.9.3 ATE: The ATE was designed using TTL logic to control telephone type rotary stepping switches. These switches cycled the radios through transmit and receive cycles and controlled monitoring equipment. Initial test problems resulted due to switch synchronization errors in the ATE. An alarm circuit monitored switch positions and would place the ATE and radios in standby if a synchronization error occured. This necessitated additional monitoring and manual resetting by the test team to assure maximum test time utilization. As testing progressed improved maintenance procedures minimized this problem. Less than 1% total test time was lost due to ATE malfunction or outage.

5. SUMMARY: The simulated operational test of the AN/GRC-171 transceiver was completed on 13 Jun 1976. A total of 172,092 relevant test hours were accumulated on thirty test transceivers. A total of ten relevant failures occured during testing. The total DMTBF at this time is 17,209.2 hours. This figure will be modified based on testing continuing on the Radio Set Control (C-7999) which will complete testing on 23 Nov 76. No significant failure trends were discovered on the RT-980/GRC-171 during the test.

DISTRIBUTION LIST

HQ AFCS

EP 1
EPEU 2
EPEL 2
EPPT 1

LG 1
LGXB 1
LGSM 1
LGM 1

FF 1
FFNR 1

OA 1

XP 1

AFCS Units

NCA
EPEL 1
EPEU 1
LG 1

SCA
EPER 1
EPEU 1

TAC COMM AREA/XPX 1

PCA-EPEL 1
EPEU 1

ECA-EPE 2

Other Agencies

Sacramento ALC - MMCRAA 1
MMCMD 1

Ogden ALC - MMSRM 2

AFLC - LOWE 2

ASD - RWVF 1

SAC - DOKM 1

CINCAD - LGMC 1

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